SEPTEMBER, 1955

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Anodizing with Chromic, Sulfuric and Oxalic Acids

Methods of Coating Plastics with Metal
Procedure for Obtaining Adherent Coatings

Electrodeposition of Nickel from Fluoborate Solutions
Investigation of Suitable Solutions and Optimum Operating Conditions

Science for Electroplaters
Valency

Complete Contents Page 63

WHERE PLATERS AND FINISHERS LOOK FOR INFORMATION
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CLEPO 166-C CLEANER

* HEAVY DUTY ANODIC STEEL ELECTROCLEANER
* COMBINES SOAK CLEANING PROPERTIES WITH ELECTROCLEANING ACTION
* GIVES EXCELLENT RESULTS ON TUBULAR AND RECESSED PARTS
* CUTS FUMING TO A MINIMUM
* A REAL WORK-HORSE WITH LONG LIFE
* CAN BE USED WITH BOTH CATHODIC AND ANODIC CURRENT

WHY DON'T YOU be one of the many satisfied users of CLEPO 166-C Cleaner? Contact your Clepo Service Representative for further information.

FREDERICK GUMM *Chemical Company Inc.*

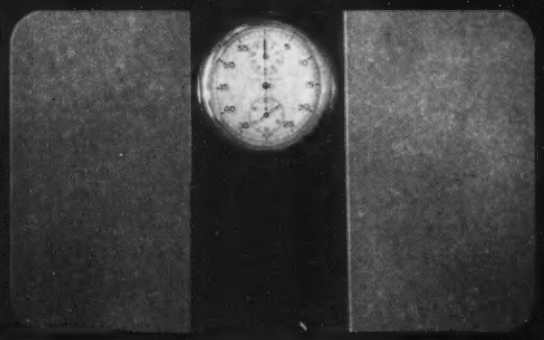
538 FOREST STREET, KEARNY, N. J.

SEP 16 1955

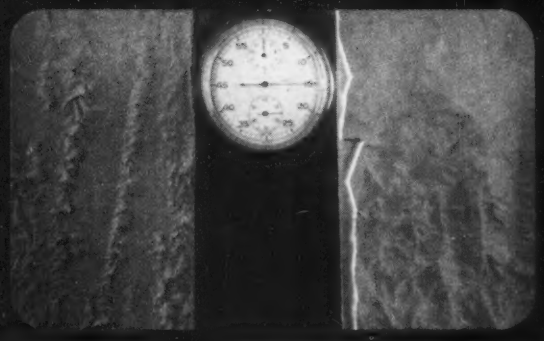
STRIPPING ENAMEL . . .

SAVING TIME

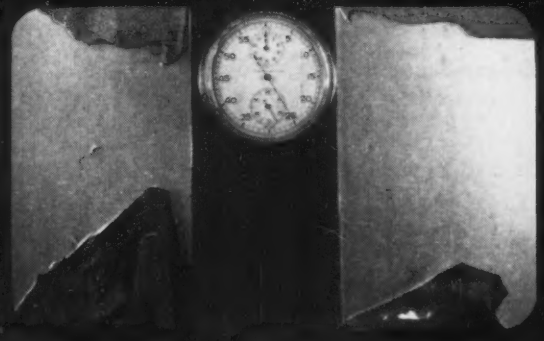
*Enthonics** AT WORK



IMMERSED . . . THE WATCH STARTS!



15 SECONDS . . . WRINKLING TAKES PLACE!



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25 seconds from immersion to completed stripping!

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And ask for your copy of the "Enthone Check List" of literature covering more than 60 products and processes developed for modern electroplating and metal finishing.

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ENTHONE INCORPORATED

METAL FINISHING PROCESSES

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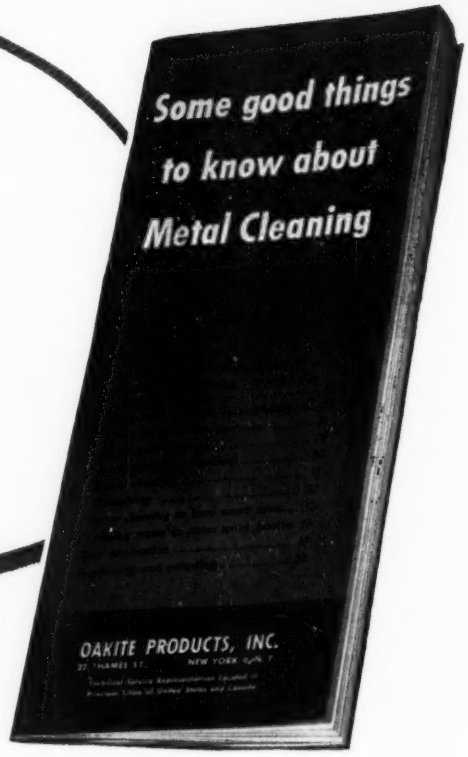
Service Representatives and Stock Points: BINGHAMTON, N. Y., Austin F. Fletcher, Inc.; CHICAGO, Ardco, Inc.; CLEVELAND, R. O. Hull & Co.; DALLAS, Weaver Engineering & Supply Co., Inc.; LOS ANGELES, L. H. Butcher Co.

WHICH OF YOUR METAL-CLEANING JOBS WOULD YOU LIKE TO IMPROVE?



¶ Are you cleaning metal in the most economical way? *See page 9 of Oakite's* FREE *booklet on Metal Cleaning.*

¶ Are you cleaning metal the fastest way? *See page 11.*

¶ Can you clean brass anodically with no tarnish? *See page 18.*

¶ Can you clean steel and prepare it for painting for less than 20 cents per 1,000 square feet? *See page 24.*

¶ Do you need a cleaner that removes rust and oil at the same time; often eliminating all need for pickling? *See page 28.*

¶ How do you clean parts that are too large to be soaked in tanks or sprayed in machines? *See page 30.*

¶ Does your burnishing barrel produce high luster? *See page 32.*

¶ What do you do when oversprayed paint neither floats nor sinks in your paint spray booth wash water? *See page 35.*

¶ Would you like to eliminate expensive drying from your anti-rust procedure? *See page 37.*

LISTED BELOW are some of the operations discussed in this 44-page illustrated booklet. Please check the jobs in which you are interested. Then let us show you how Oakite methods can give you better production with greater economy.

SPECIALIZED INDUSTRIAL CLEANING

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MATERIALS • METHODS • SERVICE

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Tell me about Oakite methods and materials for the following jobs:

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- ☐ Machine cleaning
- ☐ Electrocleaning steel
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- ☐ Pickling, deoxidizing, bright dipping
- ☐ Pre-paint treatment
- ☐ Zinc phosphate coating
- ☐ Paint stripping
- ☐ Steam-detergent cleaning
- ☐ Barrel cleaning
- ☐ Burnishing
- ☐ Rust prevention
- ☐ Treating water in paint spray booths
- ☐ Machining and grinding
- ☐ ALSO send me a FREE copy of your booklet "*Some good things to know about Metal Cleaning*"

*Name*_____

*Company*_____

*Address*_____

Technical Service Representatives in Principal Cities of U. S. and Canada

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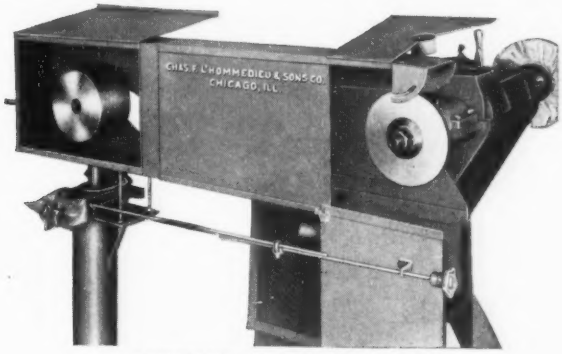
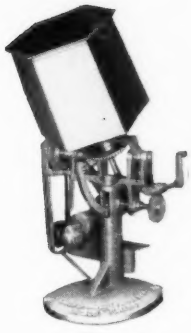
ECONOMY : EFFICIENCY : DEPENDABILITY

WRITE FOR FURTHER DETAILS



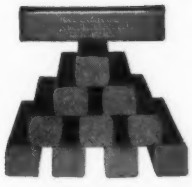
BACKSTAND IDLER WITH LATHE



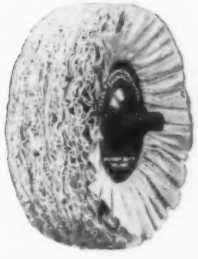
OBLIQUE
TUMBLING BARREL

#23A
POLISHING LATHE

BACKSTAND IDLER



EXTRUDED COMPOSITIONS
STANDARD SIZE
2 x 2 x 10"



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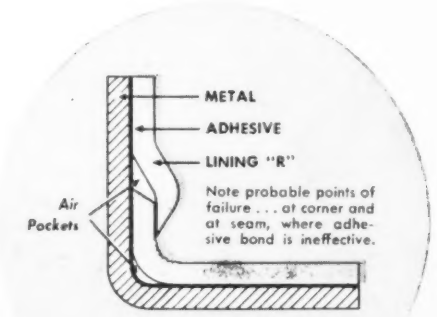
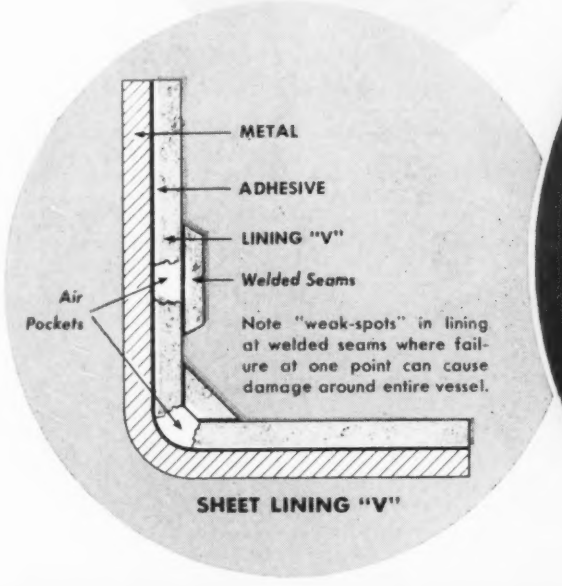
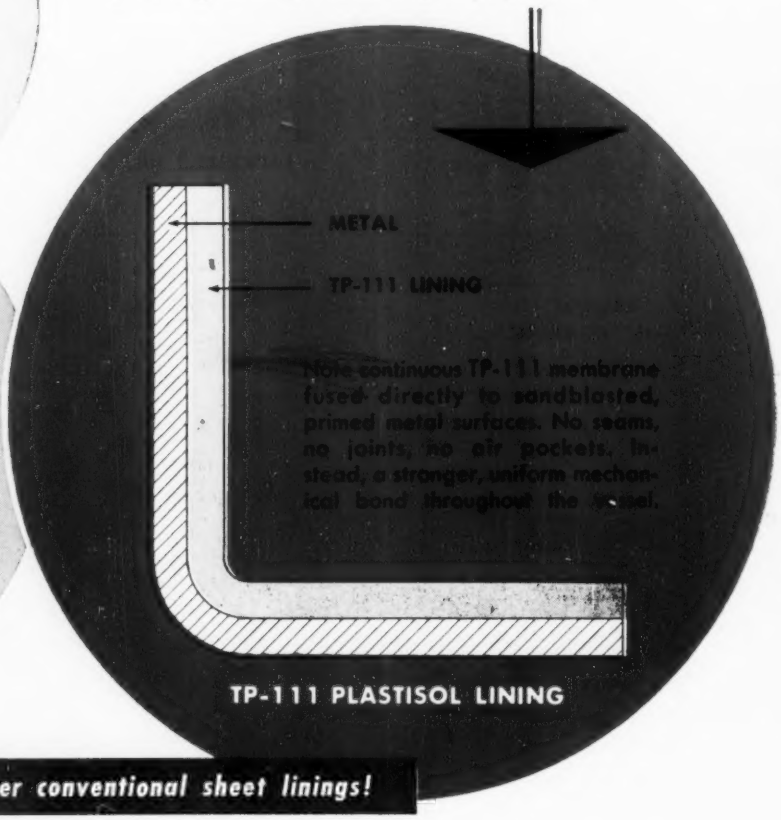

METAL
ADHESIVE
LINING "R"
Air Pockets
Note probable points of failure . . . at corner and at seam, where adhesive bond is ineffective.

SHEET LINING "R"


METAL
ADHESIVE
LINING "V"
Welded Seams
Air Pockets
Note "weak-spots" in lining at welded seams where failure at one point can cause damage around entire vessel.

SHEET LINING "V"


METAL
TP-111 LINING
Note continuous TP-111 membrane fused directly to sandblasted, primed metal surfaces. No seams, no joints, no air pockets. Instead, a stronger, uniform mechanical bond throughout the vessel.

TP-111 PLASTISOL LINING

Compare the advantages of TP-111 over conventional sheet linings!

● **CONTINUOUS MEMBRANE**—As applied by A & P Finishing specialists, TP-111 forms a continuous membrane lining completely free of the joints, seams, and air pockets normally found in conventional sheet linings. Such breaks in a lining are generally considered weak spots where failure would permit liquid to flow to various parts of the vessel, causing extensive damage and loss of current density.

● **STRONGER BOND**—A & P Finishing TP-111 is fused directly to primed, sandblasted metal surfaces . . . thus effecting a stronger mechanical bond than that produced by adhesives used with conventional linings. This also permits use of TP-111 on higher temperature applications where adhesives are apt to soften causing a separation of the sheet lining from the base metal. Further, in the event of accidental damage to the TP-111 lining, chemical attack and undercutting is localized.

● **CONTROLLED HARDNESS**—The film hardness of TP-111 can be controlled to meet individual job requirements by A & P Finishing specialists. In addition, greater chemical and abrasion resistance can be effected through formulation and curing techniques which produce an unusually dense and durable membrane.

* ***POSITIVE PROTECTION*** — Protective linings are only as effective as the method by which they are applied. That's why it pays to insist upon proven A & P Finishing TP-111 linings as installed in our plant by workmen recognized as pioneers in this field. All work guaranteed and surprisingly low in cost. Available, too, through equipment manufacturers and plating jobbers. Write for details today!

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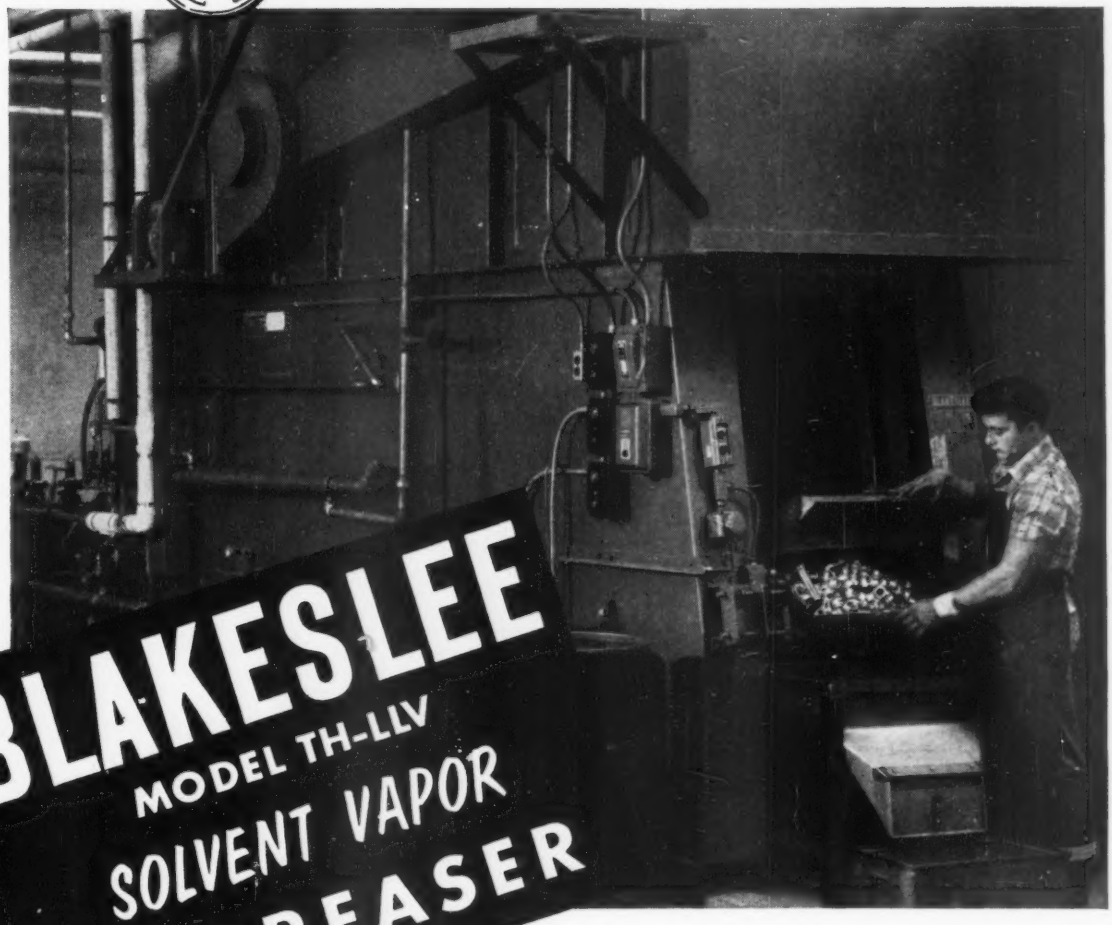
PENNY-PINCHING GIANT



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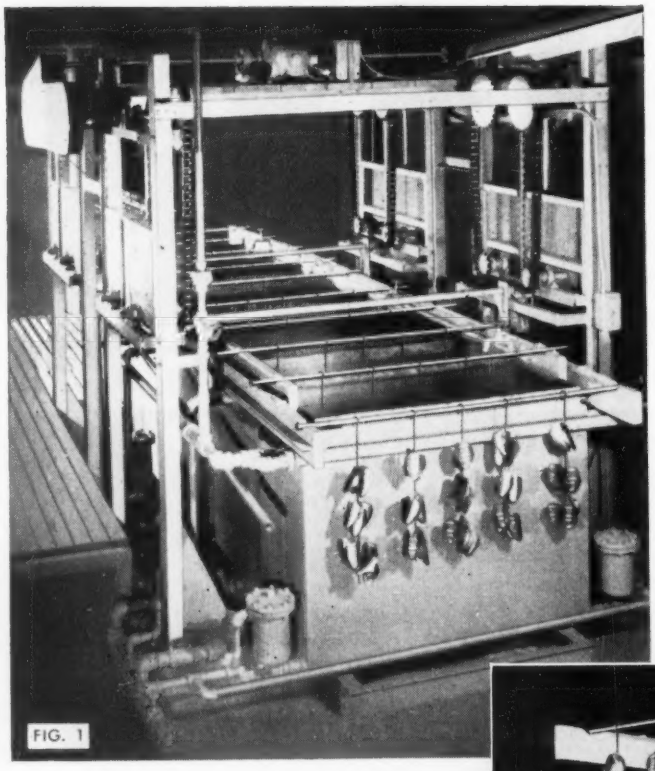
FIG. 1

NEW Automatic TRANSFER MACHINE for Pre-Plate Processing

One unit saves labor of 3 to 6 men.

Extremely flexible—different metals such as steel, brass and even die casting can be processed with the same set-up.

Shops that have BELKE Automatic Transfer Machines use them for most of their work.

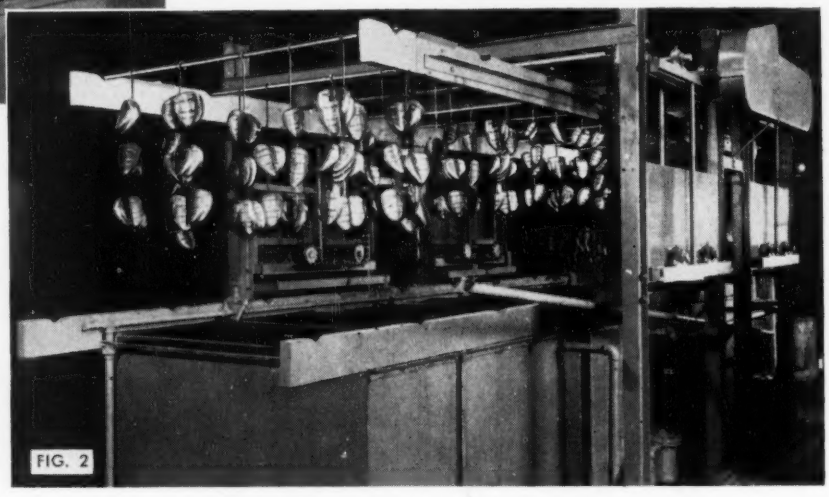
FIG. 2

Fig. 1. Loading End. Loaded racks are hung on rod placed in saddles on transfer frame. At end of each processing period the machine automatically lifts all rods and advances each one tank in the processing cycle.

Fig. 2. Delivery End. Picture shows transfer frame elevated in the transfer operation. When the frame comes down the last rod, which carries parts from the last tank in the processing cycle, will be placed in the unloading saddles on the frame which extends beyond the last tank.

Features

- Affords practically any required cycle for plating, painting, etching, etc.
- Flexible. Easily adjusted to "skip" tanks for processing articles of different basic metals without changing solution.
- Automatic Timing. Easily set for any processing period from 10 seconds to 20 minutes.
- Uniform Processing. The automatic timer doesn't forget — is not called away. Spoilage is avoided.

The BELKE Automatic Transfer Machine stops the backaches and high labor costs of processing parts for plating.

The machine automatically lifts and transfers work from tank to tank through the entire pre-plating cycle such as electrocleaning, tepid running rinse, anodic electroclean, cold running rinse, acid bath, cold running rinse, cyanide bath, cold running rinse. Practically any cycle can be had.

The Transfer Unit can be adjusted to "skip" tanks as desired for processing articles of different metals such as steel, brass and die castings. This flexibility makes practical automatic processing of a great range of varied work.

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5 Rapid Selenium Rectifiers form Power-Packed Line-up at Warner & Swasey

Warner & Swasey's chromium plating installation features a power-packed line-up of five Rapid Selenium Rectifiers. It's Rapid power, then, along with extensive know-how and other excellent equipment that helps Warner & Swasey turn out only quality chromium plating which is in keeping with their reputation for building the finest of precision, metal-turning machine tools.

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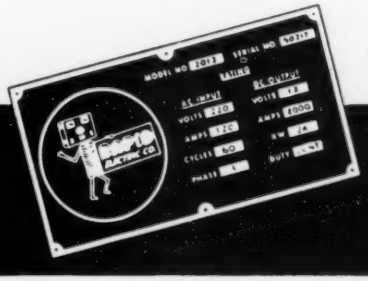
- **Long-time service**
- **High efficiency**
- **No lost time due to burnouts**
- **No loss of efficiency due to overheating**
- **No supervision needed**
- **No maintenance needed**
- **Maximum Safety Features**

Our engineering department is available for consultation on any application of Direct Current Power Supplies. Avail yourself of this professional service without obligation.



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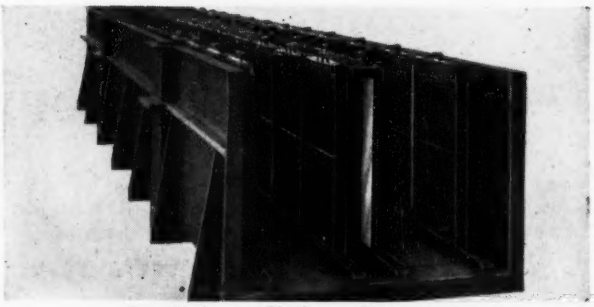
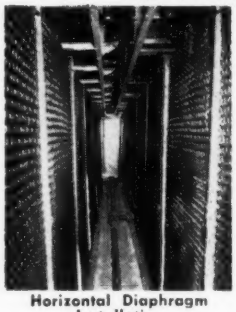
Simply, economically installed, Diaphragm Systems efficiently segregate the anolyte from the catholyte through canvas barriers between anode and cathode compartments.

This ARco electroplating method, combined with ARco Rubber Lined Tanks and planned solution circulation, filters metallic insolubles from outside sources.

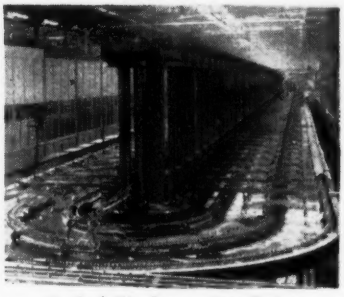
To reduce costly buffing due to roughness . . . prevent rejects resulting from thin spots . . . have an ARco engineer show you how simply Diaphragm Systems can save time, materials . . . and customers . . . for you.



Two Work Lane Diaphragm Plating Tank



Horizontal Diaphragm Installation



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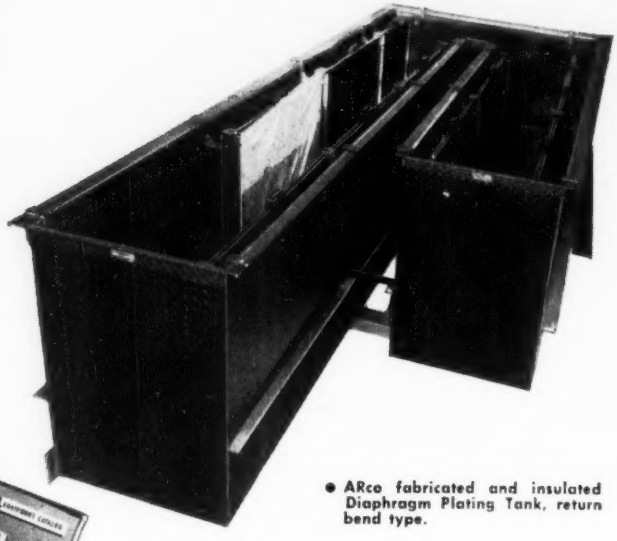
For uniformly high quality and economy in plating . . .

DIAPHRAGM SYSTEMS *and* RUBBER LINED TANKS *by* ARco



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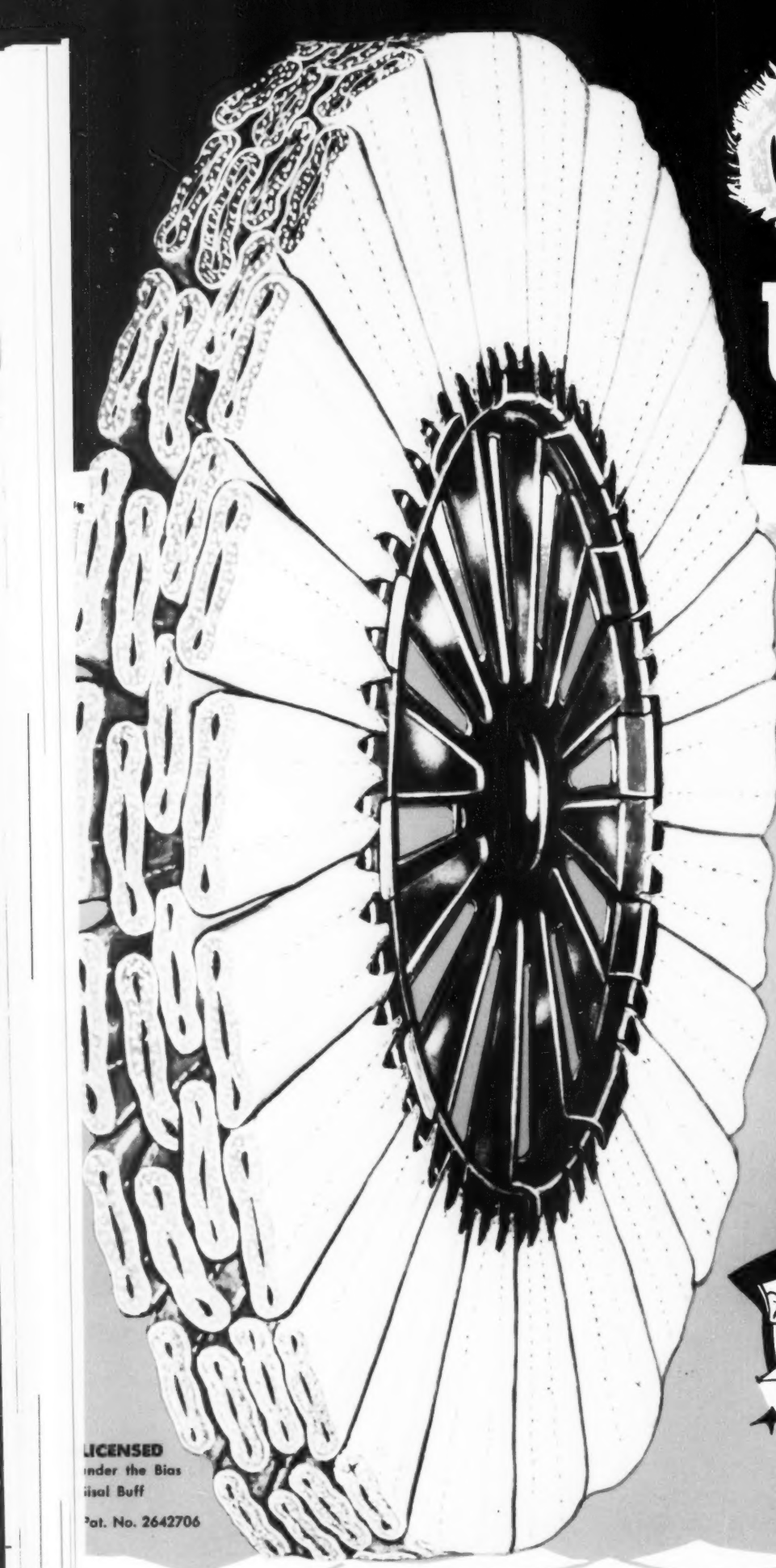

CUT with UNIT SISAL

SELF-COOLING "UNIT" DESIGN

circulates air throughout every fibre, even in high-speed operation. Keeps work always cool.

EXTRA-FLEXIBLE INDIVIDUAL "UNITS"

Apply *just the right amount* of buffing pressure at every point on both flat and curved work . . . reach into every crevice for superior polishing action on irregular surfaces.

CUTS and COLORS in ONE OPERATION

Cloth-wrapped Sisal units provide two-in-one performance! By combining fast cutting and high-lustre finishing, this buff actually accomplishes both cutting and coloring in the same operation.

Available with Permanent Steel Centers or Patented Centerless Construction.

LICENSED
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"For the job that's tough—use an AMERICAN BUFF—"

PRODUCTION COSTS

SELF-COOLING AUTOMATIC

and OPEN-FACE SISAL BUFFS

SAVE TIME!

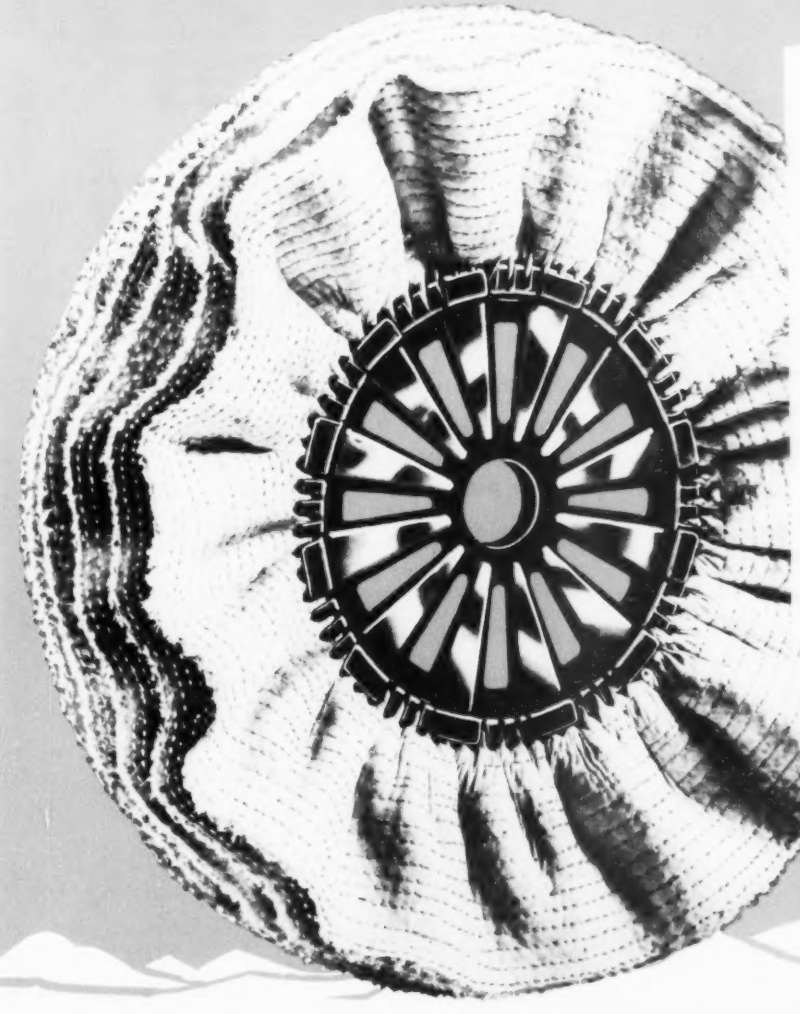
Automatic "air-cooled" buffs run faster — safely — to increase your production volume. Self-cooling construction won't burn or discolor metals . . . stays cool even at highest speeds.

SAVE WORK!

Bias Sisal and stitched double Cloth combined in flexible construction do the work in *fewer passes.* You save work . . . save buffs.

SAVE MONEY!

Economical Automatic Sisal Buffs wear longer . . . do more. Their flexible design retains buffing compound along both leading and outer edges — actually uses *less* compound!



UNIQUE CLOTH and BIAS SISAL "OPEN" BUFF

EXTRA-LOOSE CONSTRUCTION COOLS as it RUNS

Air-cooled open "ruffle" design directs cooling air currents over the work . . . permits faster speeds without heat discoloration.

CUTS AND COLORS IN ONE OPERATION

Ideal "looseness" gets into small openings and crevices . . . speeds work on both flat and contoured surfaces. Fast-cutting bias Sisal and stitched double bias Cloth turn out a finished job easier, faster, better!

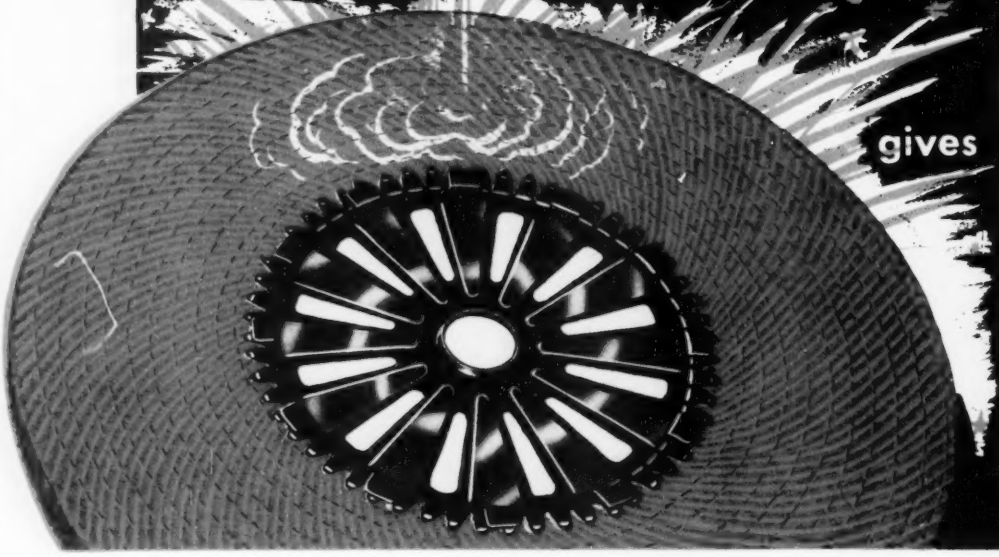
Available with or without cloth

TEST these sensational new Buffs *in your own plant.* You'll find Automatic "air-cooled" Buffs are *made to order* for greater efficiency and economy on practically *every* buffing job!

AUTOMATIC BUFF CO. DIVISION OF American Buff Company

EXCLUSIVE with AMERICAN BUFF...

The "Golden Treatment" gives SISAL remarkable new buffing qualities



There's "GOLD" for you in production with the improved buffs

An exclusive, special adhesive now holds American Buff Company's Sisal Buff fibres more closely together—gives them greater capacity to hold buffing compounds. Yet this "Golden Treatment" . . . the fruit of 4 years of research and experiment, does not produce either excessive softness or hardness in the buff's density. While its texture is virtually unchanged, its effectiveness is appreciably improved. You'll identify the new benefits by the "golden" tinge with the "golden touch."

- **Better buffing action with increased compound absorbency**
- **Faster cutting with retained compound**
- **Longer wear with closer Sisal fibres**
- **Lower costs through increased speeds, reduced waste of compound, fewer passes**

Available in all American SISAL BUFFS — Centerless or Permanent Center — or CONVENTIONAL type Sisal.

FREE *NEW* **SISAL BUFF SELECTOR**

HANDIEST BUFFING HELPER EVER OFFERED!

Picks the right buff for every job — quick as a wink! Reverse side contains jiffy calculator that instantly figures Spindle speeds, Surface speeds, etc. Sent FREE to Buff Users . . . write for yours TODAY

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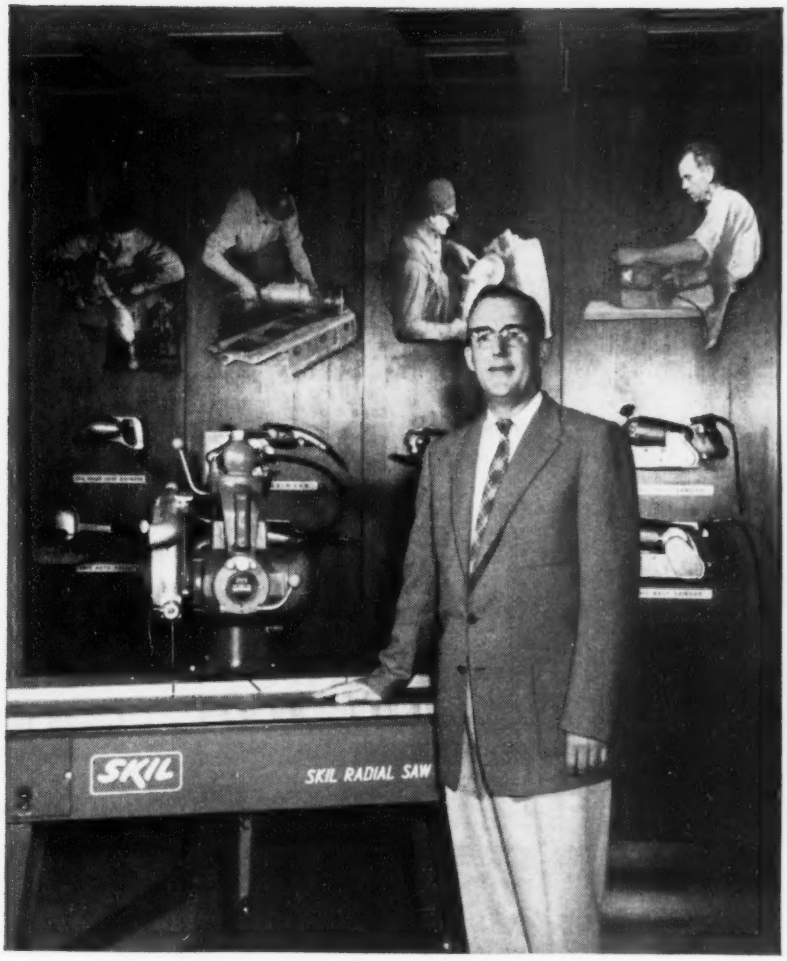
CAlumet 5-1607



Skil Corporation treats all metal parts with PRE-FOS *to prevent rust; provide paint base.*

R. W. Christensen, assistant to the vice president, Skil Corp., Chicago, Ill., says:

"We increased our production efficiency by using Wyandotte Pre-Fos"

"We originally bought PRE-FOS* for an in-process rust preventative," says R. W. Christensen, assistant to the vice president of Skil Corporation, famous makers of power tools. "We found that it provided such an excellent surface for paint, that we now treat with PRE-FOS all product parts that are to be painted. Production efficiency has increased — for it also does a better job of cleaning than our previous process. And paint *definitely* adheres better to PRE-FOS-treated surfaces."

PRE-FOS is outstanding for cleaning and phosphatizing steel, as well as nonferrous metals. It removes shop dirt and fabricating soil . . . in a spray washer or soak tank! PRE-FOS deposits a fine-grained phosphate coating, increasing the metal's corrosion resistance, and providing an excellent base for paint.

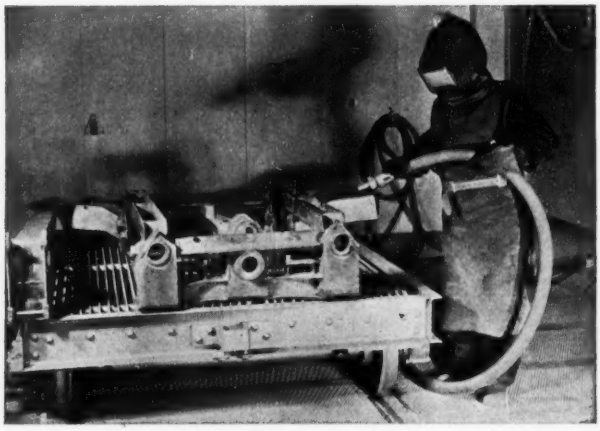
You can improve the quality of your "finish" with Wyandotte PRE-FOS — for cleaning and phosphatizing metal surfaces before paint application. You'll cut operating costs, too, because of PRE-FOS' low, low use-cost! Call your nearest Wyandotte representative today! *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, Calif. Offices in principal cities.* *REG. U.S. PAT. OFF.

Wyandotte
CHEMICALS
J. B. FORD DIVISION

Specialists in Metal-Cleaning Products

used this way ⬇

this way...



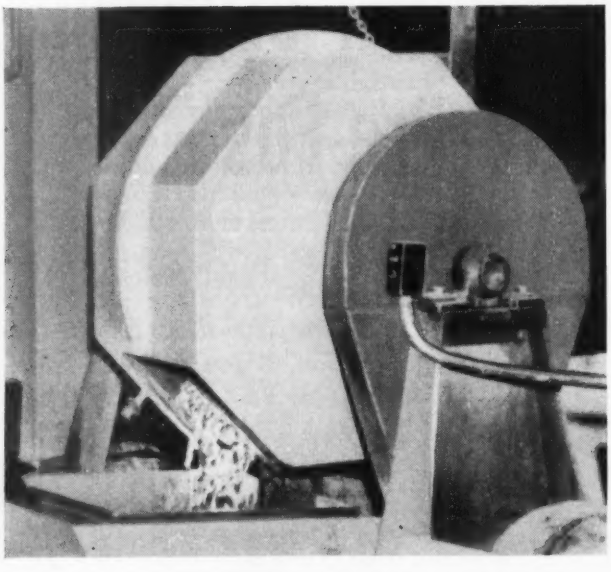
⬇

Borolon®
TRADE MARK

ABRASIVE GRAIN gives superior RESULTS

or this way

⬇



Pressure blasting, polishing or tumbling! No matter what your job, use this fused crystalline aluminum oxide. Hard, sharp, tough. In lumps, nuggets, chips, grit or grain with each particle dense and solid with well defined cutting edges. Let's send you free catalog bulletin. Just mention the type of operation you do.

SIMONDS ABRASIVE COMPANY • PHILADELPHIA 37, PA.

Branch Warehouses: Boston, Detroit, Chicago, Portland, San Francisco • Distributors in Principal Cities
Division of Simonds Saw and Steel Co., Fitchburg, Mass. • Other Simonds Companies: Simonds Steel Mills, Lockport, N.Y., Simonds Canada Saw Co., Ltd., Montreal, Quebec, Lion Grinding Wheels Div., Brockville, Ont. and Simonds Canada Abrasive Co., Ltd., Arvida, Quebec

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your

Bright Nickel Plating Bath

Should Match!

- Is it economical to operate?
- Does it produce bright, ductile, active deposits which readily accept chrome?
- Has it excellent bright throwing power?
- Can it be easily controlled through "on the job" testing procedures?
- Is it extremely tolerant to both organic and inorganic impurities?
- Are addition agents in "easy to add" liquid form?
- Does it require infrequent purification treatments?
- Can it be used over wide ranges of solution composition and operating conditions?

McGEAN

Because McGean Bright Nickel meets all these requirements . . .

it has long been established as the industry leader!

For full information . . . contact . . .

THE McGEAN CHEMICAL COMPANY

Cleveland 15, Ohio

Detroit • Grand Rapids • Chicago

New SCHAFFNER BIAS buffs

give more mileage...

because

- ...FULLY VENTILATED
- ...COOLER RUNNING
- LOW COMPOUND CONSUMPTION
- ...FEWER SECTIONS NEEDED
- ...GIVES LONGER LIFE
- ...LATHE FACED AND BALANCED

Manufactured and controlled in our own new modern up-to-date Buff plant. Can be tailor made for your toughest buffing problem

MADE BY THE MANUFACTURERS OF FAMOUS AND ACCEPTED SCHAFFNER NO NUBBIN BUFFING COMPOSITIONS.

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manufacturing company, inc.
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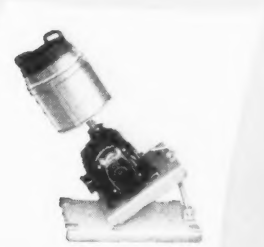
CLIP TO YOUR LETTERHEAD

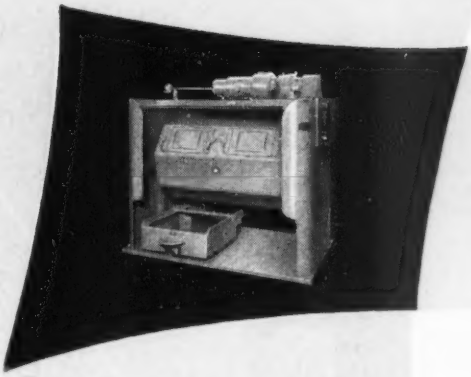
Phone ROsewood 1-9902

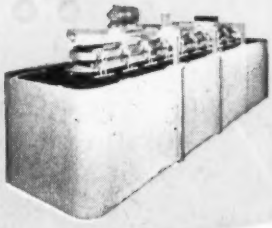
Please send me catalogue and complete information:

NOW PRESENTLY USING _____ Name, Manufacturer and _____
DIAMETER _____ Code No. of Buff _____
CENTER SIZE _____ CENTER SIZE _____
PLY _____ ARBOR _____
NORMALLY I USE _____ SECTIONS PER MONTH _____ COUNT _____
NAME _____ TITLE _____
COMPANY _____ STREET _____
CITY _____ ZONE _____ STATE _____

SCHAFFNER AIR-COOLED METAL-CENTER BUFFS ARE PRICED RIGHT • PRODUCED IN ALL DIAMETERS, CENTERS, PLYS AND COUNTS

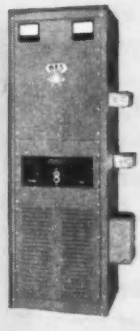


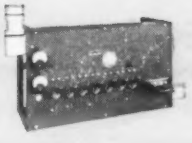


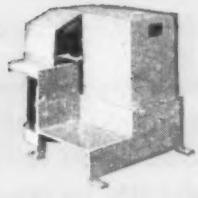


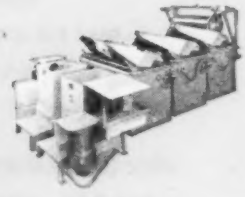
CROWN equipment

- Automatic Machines for Plating-Anodizing, etc.
- Dryers, Centrifugal
- Partially Automatic Plating Machines
- Plating Barrels
- Rectifiers
- Rheostats, Switches — Controls
- Tray — Transfer Type Cleaning — Rinsing — Dipping Units
- Tumbling Barrels — "Horizontal" — "Tilting"
- Special equipment designed and built









COMPLETE DETAILS SENT PROMPTLY ON REQUEST

CROWN RHEOSTAT AND SUPPLY COMPANY

3465 N. KIMBALL AVENUE • CHICAGO 18, ILLINOIS

99.75% Chromic Acid purity

$Cr O_3$ . . . . . 99.75% MIN. SO_4 . . . . . 0.1% MAX.

When a commercial chemical runs 99.75% pure, the user need not ordinarily concern himself about the remaining 0.25%. In chromium plating, however, the 0.25% is important because it includes whatever sulfate is present.

While the maximum amount of sulfate permitted in Mutual Chromic Acid is only 0.1%, average production is well below that figure. Furthermore, the sulfate content varies but little from drum to drum. No other impurity exceeds 0.01%. The balance represents a trace of moisture which, of course, is harmless. This close attention to small details is one reason for the wide acceptance of the Mutual label wherever quality chromium plating is performed.

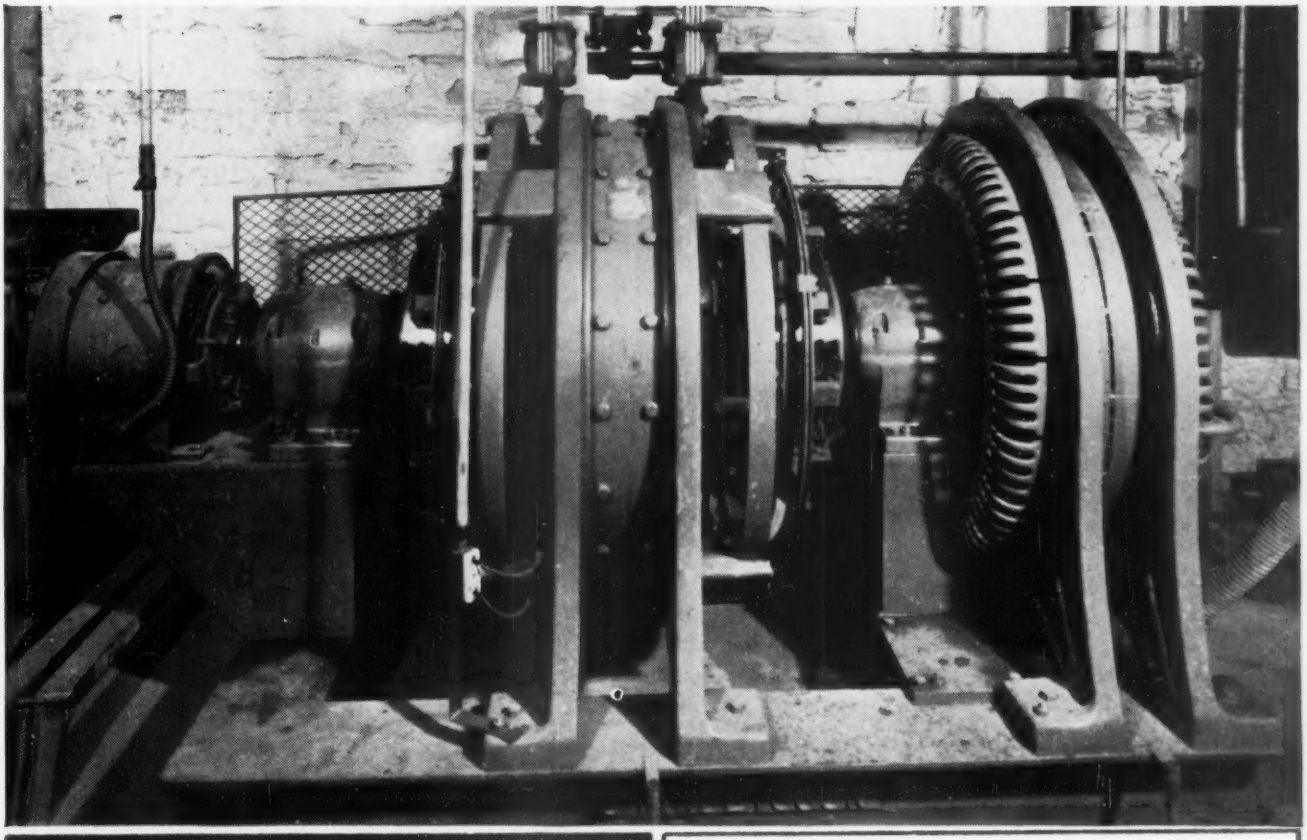
Sodium Bichromate • Chromic Acid • Potassium Bichromate

MUTUAL CHEMICAL DIVISION

MUTUAL — ALLIED CHEMICAL & DYE CORPORATION

99 PARK AVENUE • NEW YORK 16, N. Y.

Allied Chemical



INDUSTRY LEADERS CHOOSE

Chandeysson

Example:

ELECTROLYTIC GENERATORS

At PRECISION ENGINEERING CORPORATION . . . this rugged 7500 ampere, 6 volt Chandeysson Motor Generator provides dependable low-voltage power for a wide range of production operations.

THE LONG LIFE of Chandeysson Motor Generators is dramatically demonstrated by the fact that some of the first Chandeysson units ever built . . . half a century ago . . . are still giving reliable service, day after day.

YOU SAVE 4 WAYS WITH Chandeysson GENERATORS

Use Less Power . . . precision-built for efficiency and built-in voltage regulation.

Be Sure of Power When You Need It Most . . . overload capacity as great as 50% momentarily and 25% sustained, without distress or damage.

Get More Out of the Power You Pay for . . . built-in high power factor at no extra cost.

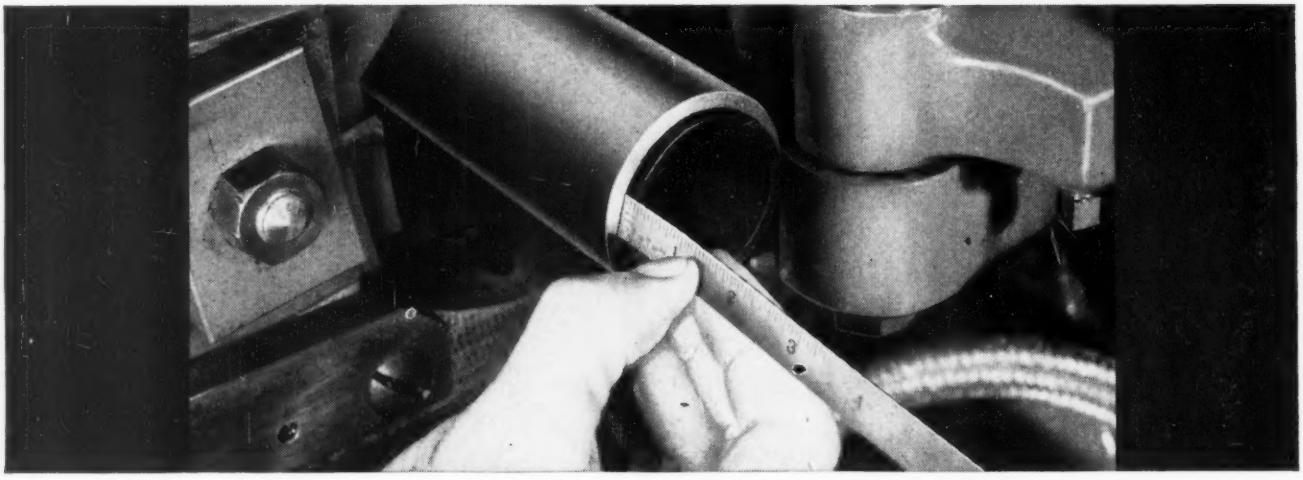
Enjoy Lifetime Power Dividends . . . sustained, lifetime overall constant efficiency as high as 85% does not decrease with age or overload.

59

For product information write for bulletins D-101 and D-102—for names of users and installation data ask for bulletin D-104.

CHANDEYSSON ELECTRIC COMPANY • **4074 Bingham Ave., St. Louis 16, Missouri**

DOW



You Can See Why

SARAN LINED PIPE

CUTS CORROSION COSTS

Corrosion resistant Saran Pipe swaged into steel is your answer to downtime losses.

Saran lined pipe, fittings and valves are built to convey acids, alkalies and other corrosive liquids at low over-all costs. The durable inner lining eliminates shutdowns due to corrosion and forms snug, tight-fitting joints that prevent leakage.

Saran lined pipes, fittings, and valves are easily and inexpensively installed. They are cut and threaded in the field with any standard pipe fitter's tools. Because of saran lined pipe's rigidity, even long spans require a minimum of support.

If your operation requires the conveying of corrosive liquids, and if downtime losses are troubling you, investigate saran lined pipe, fittings, and valves today. For further information, contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Mich. Dept. 526C-2

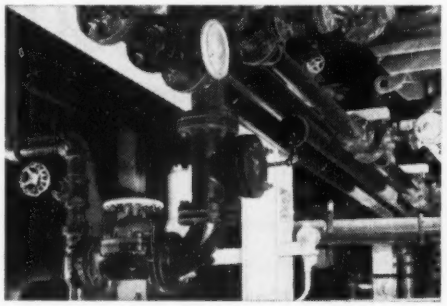
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY INSTALLATIONS USING

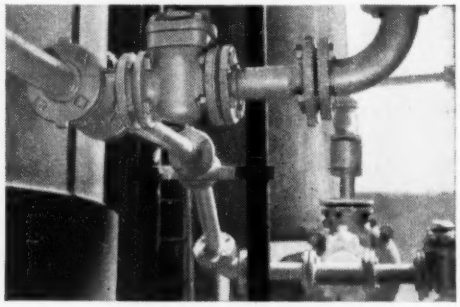
SARAN LINED

STEEL PIPE

Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan



A large chemical company uses this installation to convey demineralized water. It has a perfect record of keeping the water free of contamination for five years!



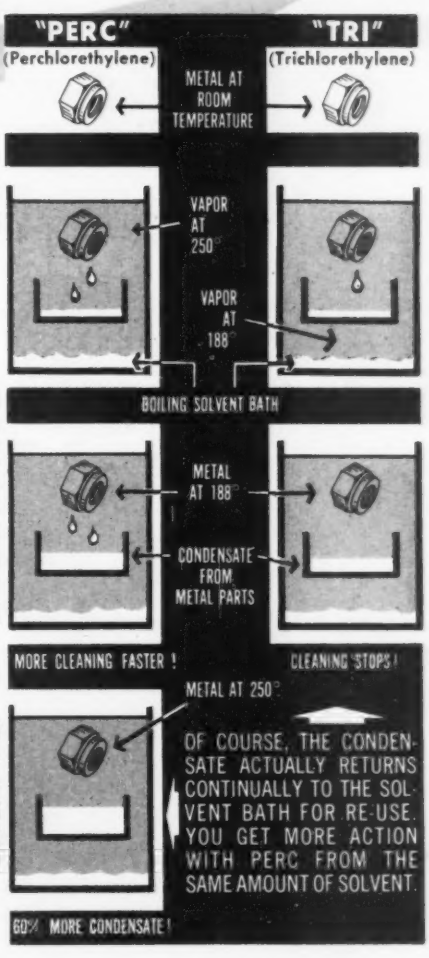
Saran lined pipe used for conveying hydrochloric acid at temperatures from 20° to 90°C., has had no unscheduled interruptions due to corrosion for over two years!

you can depend on DOW PLASTICS DOW

DO YOU KNOW

the advantages in VAPOR DEGREASING with PERCHLORETHYLENE ?

REGARDLESS OF THE TYPE, SHAPE, OR QUANTITY OF METAL BEING DEGREASED...


"PERC"
(Perchlorethylene)
"TRI"
(Trichlorethylene)
METAL AT ROOM TEMPERATURE
VAPOR AT 250°
VAPOR AT 188°
BOILING SOLVENT BATH
METAL AT 188°
CONDENSATE FROM METAL PARTS
MORE CLEANING FASTER !
CLEANING STOPS !
METAL AT 250°
OF COURSE, THE CONDENSATE ACTUALLY RETURNS CONTINUALLY TO THE SOLVENT BATH FOR RE-USE. YOU GET MORE ACTION WITH PERC FROM THE SAME AMOUNT OF SOLVENT.
60% MORE CONDENSATE !

... **PERC** VAPOR WILL START TO CONDENSE AT A FASTER RATE THAN TRI ...

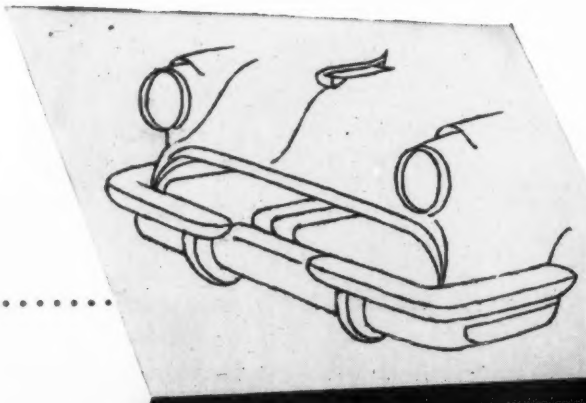
... AND WHEN THE METAL IN TRI HAS REACHED THE MAXIMUM VAPOR TEMPERATURE (AND CLEANING ACTION HAS STOPPED), **PERC** HAS ALREADY PRODUCED 6% MORE CONDENSATE—**AND IS STILL CONDENSING,** GIVING EXCELLENT CLEANING AT THESE HIGH TEMPERATURES ...

... UNTIL THE METAL HAS REACHED THE HIGHER MAXIMUM **PERC** VAPOR TEMPERATURE. **PERC** DEGREASING GIVES AT LEAST **60% MORE** CLEANING ACTION THAN TRI!

Metal finishers are converting to degreasing systems designed for perchlorethylene because of its greater efficiency in cleaning and solvent recovery. In your present or contemplated installation you'll want Stauffer's specially stabilized degreasing grade of Perchlorethylene. **STAUFFER CHEMICAL COMPANY, 380 Madison Avenue, New York 17, N. Y.; sales offices in principal cities.**

Stauffer CHEMICALS SINCE 1885

STAUFFER PERCHLORETHYLENE



HARSHAW electroplating CHEMICALS and ANODES

nickel plating

... still and barrel ... nickel anodes—all commercial grades and sizes ... anode bags ... single nickel salts—nickel chloride ... nickel carbonate ... nickel fluoborate ... boric acid.

chromium plating

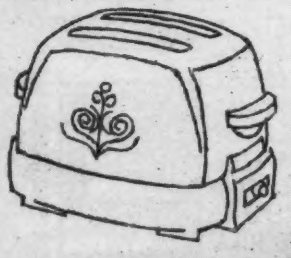
... pure "Krome Flake" 99.8% CrO_3 ... sulphates less than .10% ... lead, tin-lead and antimony-lead anodes.

copper plating

... copper ball anodes ... Rochelle Salts ... sodium and copper cyanides ... copper sulfate ... copper fluoborate.

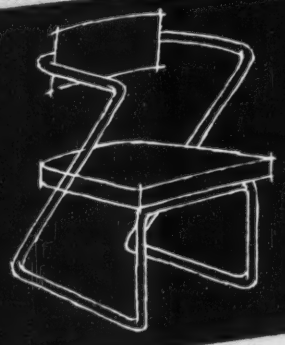
cadmium plating

... ball and cast cadmium anodes ... cadmium oxide ... sodium cyanide ... cadmium fluoborate.



tin plating

... cast tin anodes ... sodium stannate ... stannous sulfate ... tin fluoborate ... acid tin addition agent.

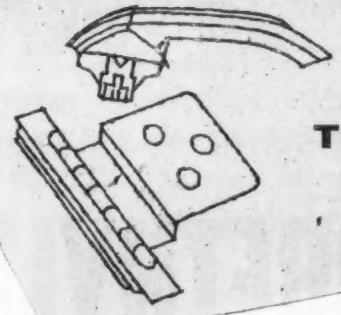


zinc plating

... ball and cast zinc anodes ... sodium and zinc cyanide ... zinc sulfate ... zinc fluoborate.

lead plating

... cast lead anodes ... lead fluoborate.



silver plating

... silver cyanide.

THE HARSHAW CHEMICAL COMPANY

Cleveland 6, Ohio

Chicago 10, Ill. • Cincinnati 13, Ohio • Detroit 28, Mich.
Houston 11, Texas • Los Angeles 22, Calif. • Philadelphia 48, Pa.
Pittsburgh 22, Pa. • New York 17, N. Y.

SLASH COATING COSTS—
INCREASE PRODUCTION
WITH THE NEW
MURRAY WAY
ROLLER COATER

- Coats one or both sides of work.
- Ruggedly built for high production.
- Unusually compact design.
- New type construction permits fast, easy access to rolls.
- Rolls may be removed without disturbing drive.
- Upper and lower rolls have separate drives.
- Bearings and drive mechanism are effectively shielded from coating fluid.
- Easily accessible Vernier roll adjustments.

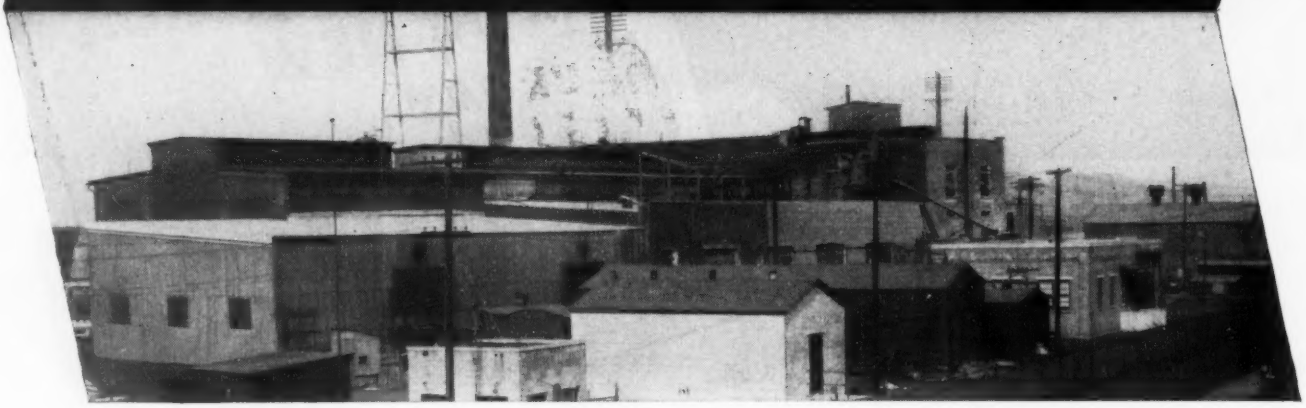
You can buff, polish, grind, coat or filter BETTER with Murray-Way

MURRAY WAY

MURRAY-WAY CORPORATION
P. O. BOX 180, MAPLE ROAD EAST · BIRMINGHAM, MICH.
Polishing, Buffing, Grinding, Filtering Equipment that automatically cuts your costs.

Before the opening of new facilities at Painesville, Ohio (top photo) . . .

New Chromic Acid Plant Brings Faster Service, Lower Freight Rates to Mid-West Platers



. . . DIAMOND produced all its chromic acid at Kearny, N. J. (bottom photo). Now, DIAMOND has two completely integrated plants.

With the addition of a basic chromic acid installation at Painesville—first in the mid-west—DIAMOND now offers platers outstanding service, faster deliveries, lower freight costs.

DIAMOND facilities—two chromic acid plants and nine warehouse points and sales offices across the country—assure you uninterrupted supply. DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

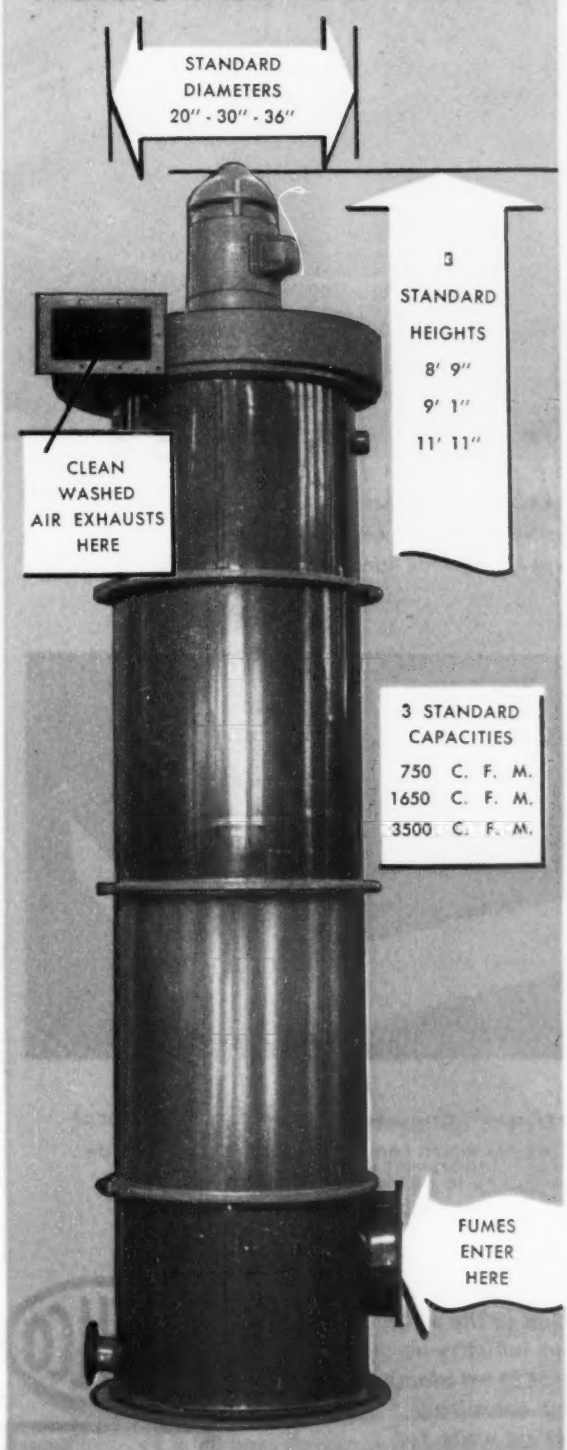
DIAMOND ALKALI CHEMICALS ®

DIAMOND CHROMIC ACID

NOW, CORROSIVE FUMES EFFICIENTLY REMOVED BY NEW "PINT SIZED," LOW COST

Cyclonaire PORTABLE

FUME WASHER


STANDARD DIAMETERS 20" - 30" - 36"
3 STANDARD HEIGHTS 8' 9" 9' 1" 11' 11"
CLEAN WASHED AIR EXHAUSTS HERE
3 STANDARD CAPACITIES 750 C. F. M. 1650 C. F. M. 3500 C. F. M.
FUMES ENTER HERE

Absorbs noxious and corrosive fumes
Removes irritating and abrasive dusts
Supresses oil and acid mists

The Cyclonaire is surprisingly compact—will fit almost anywhere, but it does a big fume removal job formerly possible only with expensive custom-designed units. It will safely handle corrosives in low concentrations normally encountered in fume scrubbing operations. Removal of many gases (of 1% concentration or less)—is up to 99.9% effective. Low power requirements make it very economical to operate.

In operation the Cyclonaire is a wet bed scrubber—with an all important difference. Instead of designing the unit first, then selecting a packing . . . our engineers designed the unit around Intalox saddle packing, the most efficient industrial tower packing made. The results surprised even us. We discovered that it is possible to do a big fume removal job with a small fume washer . . . when packed with Intalox!

The Cyclonaire is constructed of steel in easy-to-assemble flanged sections, secured by split ring clamps (the 36" size is bolted). All inner and outer surfaces are protected by an inert Tygon or Tygoflex plastic coating. It can be assembled in a few hours, or disassembled and reinstalled in a different location in an equally short time.

The Cyclonaire is available in three standard sizes and three capacities. (See illustration.) It is shipped as a "package" unit complete with motor and adequate Intalox packing. Special parts are available to convert standard units for unusual applications.

If you have a fume, dust or mist problem it will pay you to look into the low cost . . . pint sized . . . high efficiency Cyclonaire.

Get all the facts...

Send today for Bulletin FW-4. Get the complete story on this modern money saving, space saving method of fume elimination.

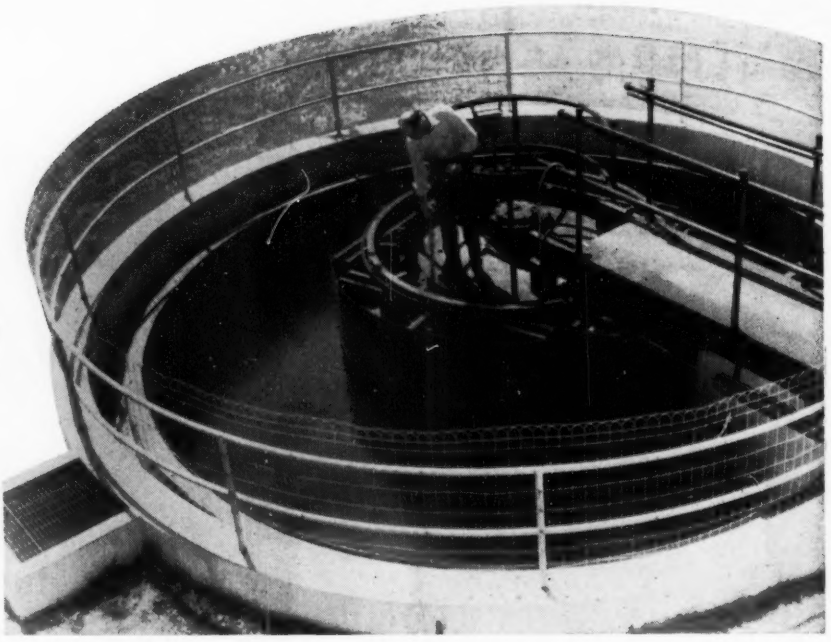
PROCESS EQUIPMENT DIVISION

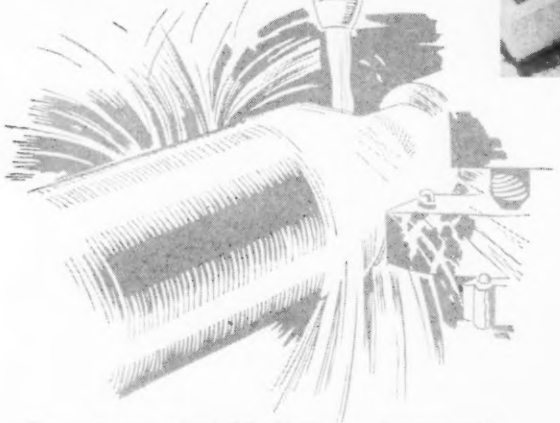
U. S. STONEWARE

AKRON 9, OHIO

135E

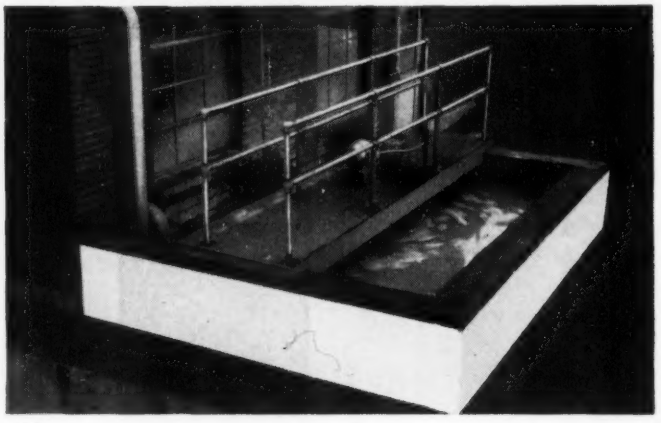
Disposal of metal finishing wastes–as easy as 1-2-3!





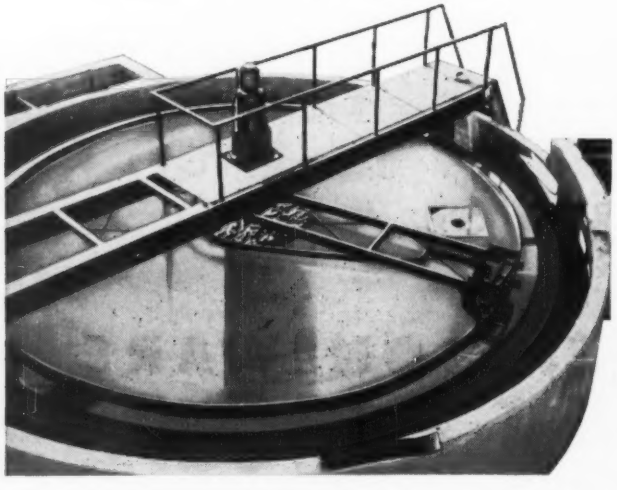
1. CYCLATOR® Clarifier: A high-capacity unit for removing metals, soluble oils and suspended solids, and for pH adjustment.

Treatment of pickle liquors, detergents, plating solutions, coolants and rinse waters is rapid and economical when you use INFILCO equipment. One or more of the units shown here will provide a permanent solution for your waste disposal problem.



2. VORTI-MIX® Circulator: For primary treatment of plating wastes which contain chromates and cyanide. Also applied to pickle liquor neutralization and cracking of oil emulsions.

3. PRIMARY CLARIFIER: For recovery of oil and removal of settleable solids when two stage treatment is required.



The proven success of this equipment in the metal finishing industry is your assurance of satisfaction. See your consulting engineer or write for complete information.

INFILCO INC.
912 South Campbell Ave.,
Tucson, Arizona
Offices in principal cities in North America

INFILCO

The one company offering equipment for all types of water and waste treatment—coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

8522A

STRIP PAINT FROM PLASTIC

with NORTHWEST'S *NEW* liquid stripper #11

This new stripper will remove most organic finishes from plastic WITHOUT attacking the base material.

Stripper No. 11 is safe and efficient. It is non-toxic, creates no fire hazard, fumes or odor.

The paint film is converted into a form easily rinsed off with water spray. Processed parts are FULLY cleaned ready for refinishing.

If you want real production results with economy call the Northwest Cleaning Specialist. There's a tested Northwest product to fit every cleaning requirement.

Remember — YOUR COST PER FINISHED ARTICLE IS THE TRUE COST OF YOUR CLEANER.

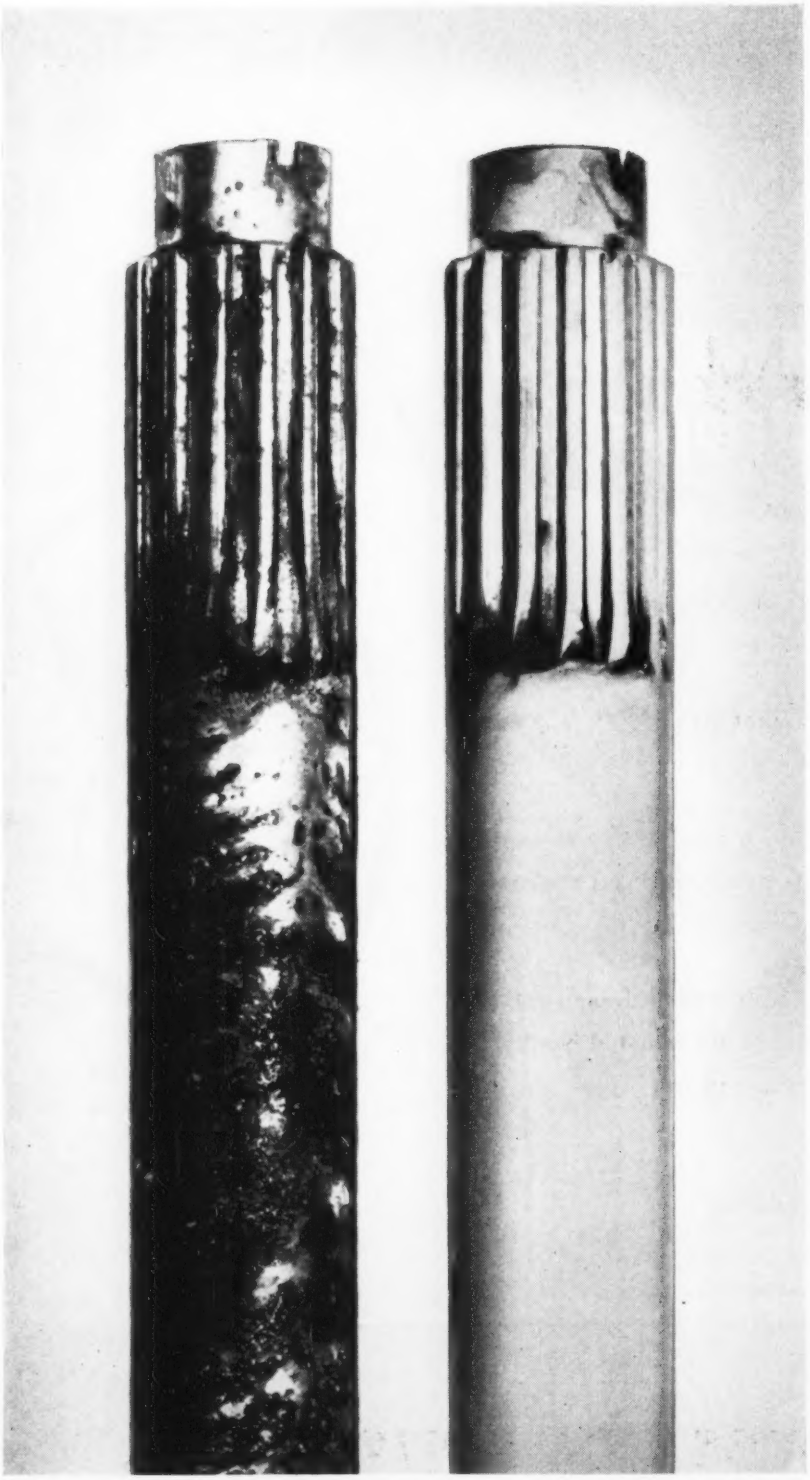
LO HI pH

NORTHWEST CHEMICAL CO.

9310 ROSELAWN DETROIT 4, MICH.

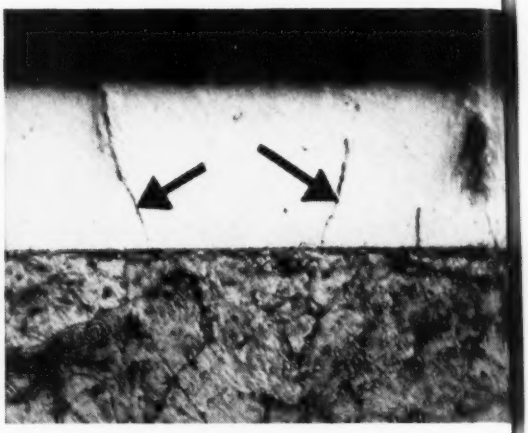
Pioneers in oil cleaning ... serving you since '32

At last! Superior Protection with

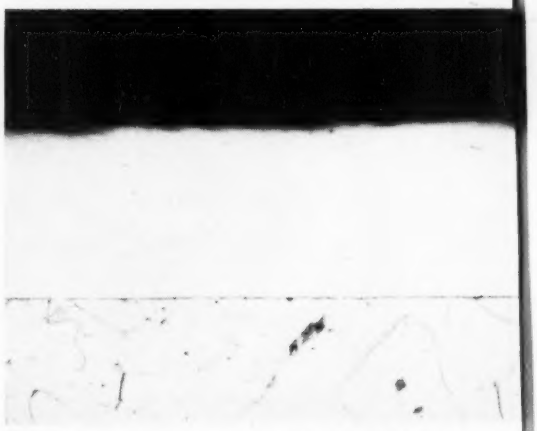


Surface of steel shaft at left, with 0.0005 inch of ordinary chromium, showed rust over entire surface after 100-hour salt spray test.

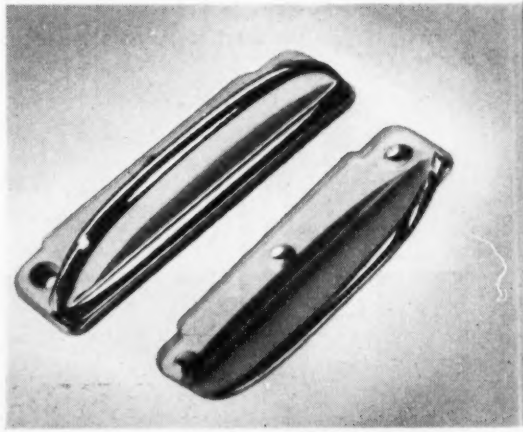
Shaft at right, with 0.0005 inch of Crack-Free Chromium, was virtually unaffected in the same test.



Photomicrograph showing cross section of etched ordinary chromium plate .00125" thick. Some cracks extend through the deposit to the steel.



Photomicrograph of a cross section of etched Crack-Free Chromium also .00125" thick. Note the absence of cracks.



Parts showing the matte finish of the Crack-Free Chromium deposit and the two tone effect achieved by buffing portions of the work.

New Crack-Free Chromium

Now . . . more corrosion-resistant chromium plating made possible by Unichrome Crack-Free Chromium Process

Here's the new production process that solves a basic problem . . . that of getting a chromium deposit free from corrosion-admitting cracks. Again an important and long awaited advance in chromium plating has been achieved by United Chromium.

Unichrome Crack-Free Chromium Plating gives ductile deposits which are relatively free from internal stress. Thus, unlike ordinary chromium deposits, they do not crack as thickness builds up. They offer you crack-free finishes that assure longer service life, greater reliability and protection

Superior Corrosion Resistance

In hard plate thicknesses, Crack-Free Chromium gives striking results. Even when plated directly on the base metal, it provides a dependable barrier to corrosion. Ordinary chromium of the same thickness is full of cracks—cracks so small they are usually not visible to the unaided eye. Many of these cracks extend all the way down to the base metal, making it impossible for ordinary chromium alone to deliver complete protection against corrosion.

In 100% relative humidity tests, conducted at 110°F, parts plated with .0003" of Crack-Free Chromium were rust-free after a full year of exposure. Parts plated with ordinary chromium were completely covered with rust after just a few days. In laboratory and outdoor exposure tests, Crack-Free Chromium has proved its superiority time and time again.

Two-Tone Finish

A matte, gray plate, Crack-Free Chromium buffs up readily, like dull nickel, to a high lustre. You can get smart two-tone effects by coloring up only portions of the work.

LOOK WHAT YOU GAIN WITH UNICHROME CRACK-FREE CHROMIUM PLATE

- **Much better protection against corrosion than with ordinary hard chromium**
- **Remarkable leveling action covers surface imperfections**
- **Improved non-galling, non-seizing properties**
- **Easier, faster grinding**
- **Resistance to thermal shock — better protection at elevated temperature**
- **Impact resistance**
- **More ductile deposit**
- **Easy buffing — as easily as dull nickel**

Conserves Nickel

Since it develops a dense, continuous deposit, Crack-Free Chromium doesn't depend on scarce nickel to stop corrosive agents from reaching the base metal. It protects all by itself . . . can be plated directly on steel and zinc die castings for many applications.

Easy Operation

The Unichrome Crack-Free Chromium solution is of the self-regulating type. Important constituents are automatically regulated, simplifying plating operations and solution maintenance. The usual chromium plating equipment is used.

Get more information. Send for Bulletin CFC-1. Or ask for a United Chromium engineer to give you the details personally.

UNICHROME Trade Mark

UNITED CHROMIUM DIVISION

METAL & THERMIT CORPORATION

100 East 42nd Street, New York 17, N. Y. • Detroit 20, Mich. • Waterbury 20, Conn.
East Chicago, Ind. • El Segundo, Calif. • In Canada: United Chromium Limited, Toronto, Ont.

PACKER MACHINE INTRODUCES

NEW COMPOUND APPLICATOR

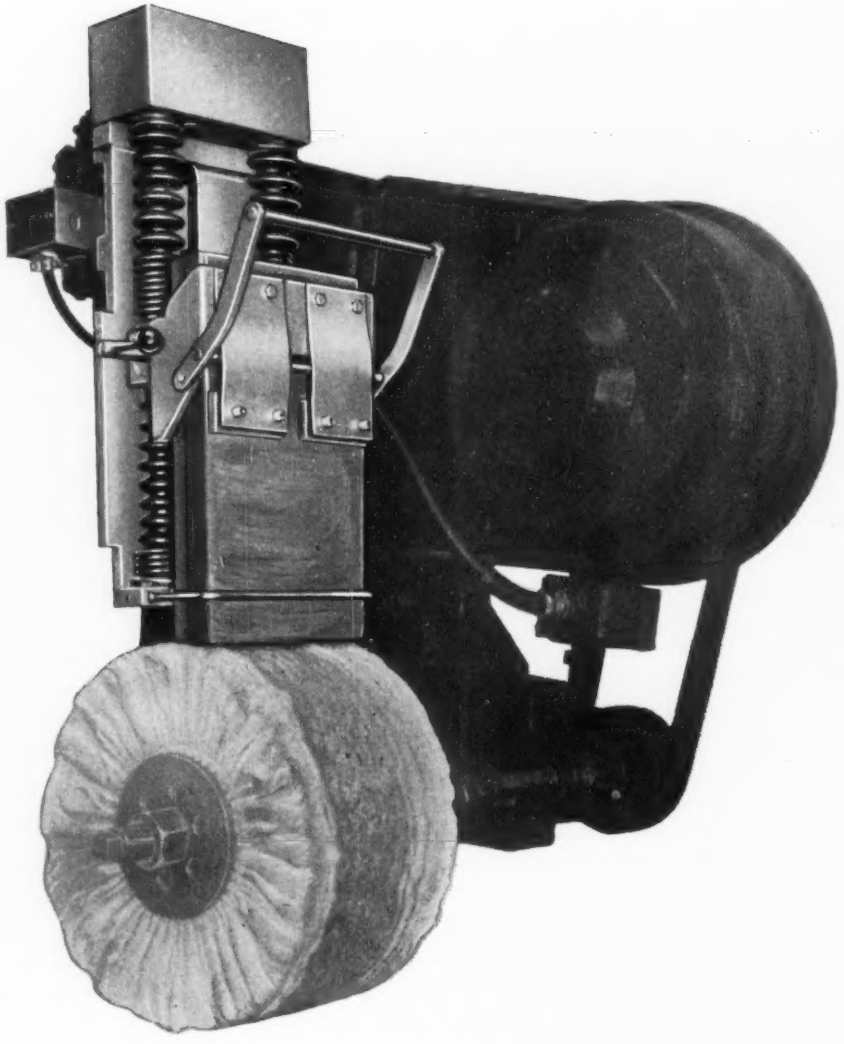
That Will Improve Your Present Equipment

Now PACKER MACHINE CO., offers users of Automatic, Semi-Automatic and Hand Jack Equipment, an all new, completely enclosed, automatic compound applicator that will increase your operator's buffing output per hour and cut bar compound waste to a minimum.

As pioneer builders of Automatic Polishing and Buffing Machinery, Packer combined years of experience and engineering "know-how" to perfect this new automatic applicator.

It is designed to hold any length bar compound and rouge 2" thick, and will feed 10" of compound to a buffing wheel in one setting.

Power is provided by a 1/20 H.P. motorized reducer drive — 115 volts, single phase; 220 volt unit optional.



ADAPTABLE TO AUTOMATIC, SEMI-AUTOMATIC AND HAND JACK EQUIPMENT

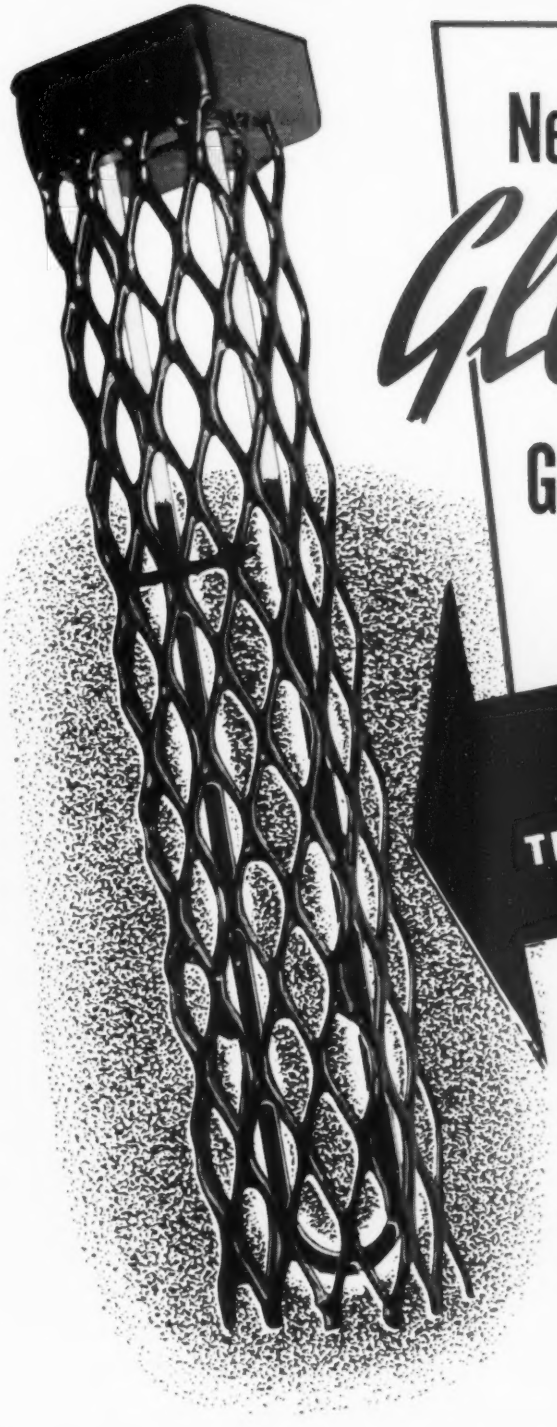
For further details on the Model #60 Applicator, phone, wire, or write E. C. Ness.

PACKER-MATIC

AUTOMATIC MACHINES FOR BUFFING • POLISHING • DEBURRING

THE PACKER MACHINE CO.

MERIDEN, CONNECTICUT



New! Revolutionary! Type "U"

Glo-QUARTZ* Heater

Gives Amazing Performance

TYPE "U"
PAT. PENDING
TRANSLUCENT FUSED QUARTZ IMMERSION HEATER

Guaranteed for One Year

World's First Successful "U" Tube Heater

First Major Improvement in Quartz Immersion Heaters in 35 years

- **HEATS INSTANTLY**
- **100% SHORT-PROOF CONSTRUCTION**
- **100% THERMAL AND MECHANICAL SHOCK-PROOF CONSTRUCTION**
- **GUARANTEED TO OUT-PERFORM AND OUT-LAST ALL OTHER QUARTZ HEATERS**

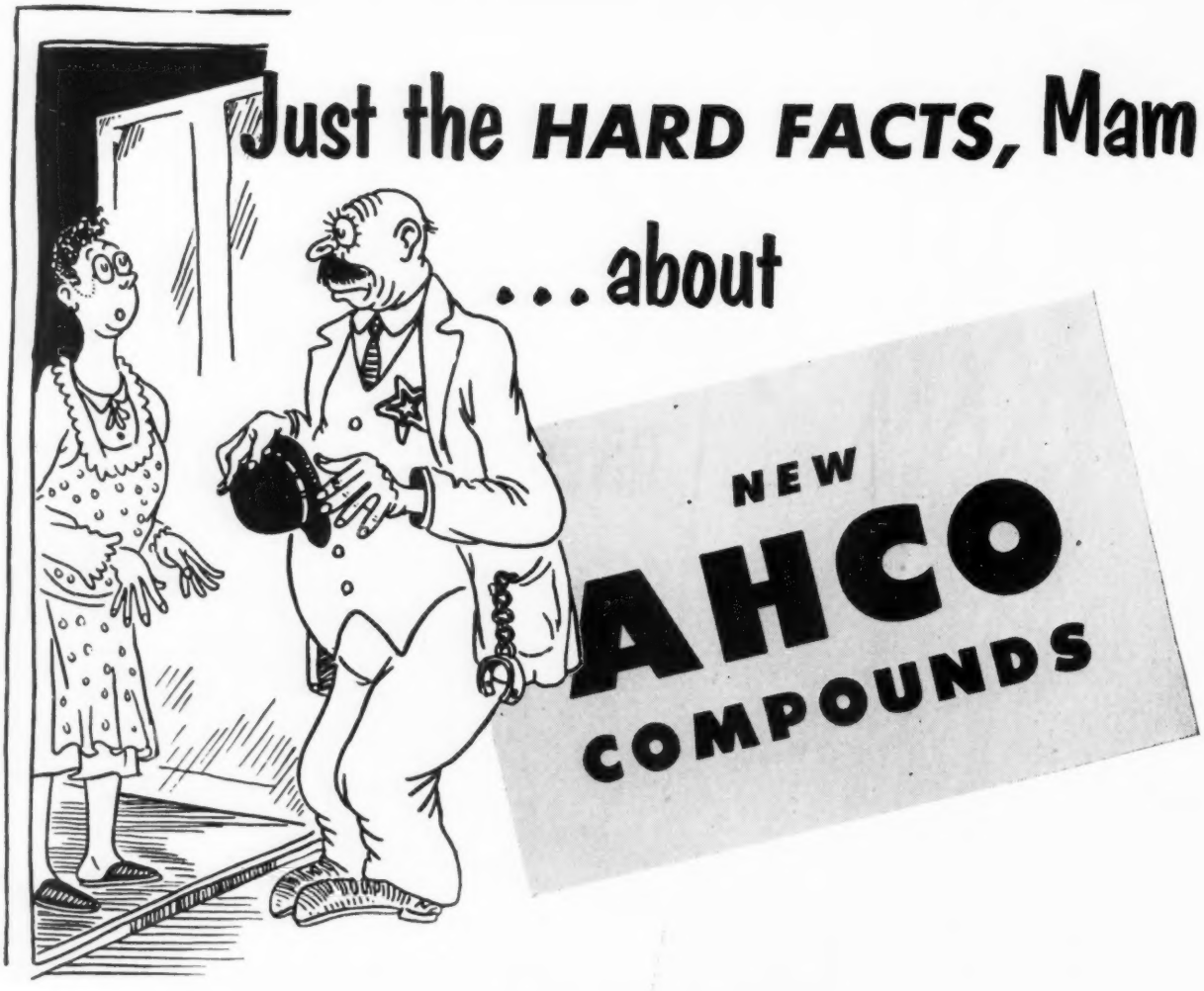
Big Savings For You With Type "U" Immersion Heaters

You get much longer service life with greatly improved accuracy and heating efficiency from the new Type "U" Glo-Quartz Heaters. Order today—and save time, trouble, money!

WRITE, WIRE or PHONE FOR BULLETINS AND PRICES

Standard Sizes in Stock for Immediate Shipment

Glo-QUARTZ ELECTRIC HEATER CO., INC.



for AUTOMATIC BUFFING

High-speed automatic buffing needs very hard and stable compounds to operate efficiently — hard to withstand tough usage . . . stable to withstand extreme heat. Now Apothecaries Hall Company has formulated a new series of high speed buffing bars that always adhere to the wheel, never lose their abrasive quality.

This new Ahco series includes tripoli bars, white bars, and other compounds for buffing surfaces from plastics to non-ferrous metals, steel, and stainless. There is a wide variety of uniform sizes for all types of machines.

Like all Ahco compounds, these new high-speed bars are manufactured under strict laboratory control to assure outstanding performance. Investigate these latest results of Ahco research NOW.

For full details about Ahco Compounds for automatic buffing, write today to Apothecaries Hall Company, 22 Benedict Street, Waterbury, Connecticut.

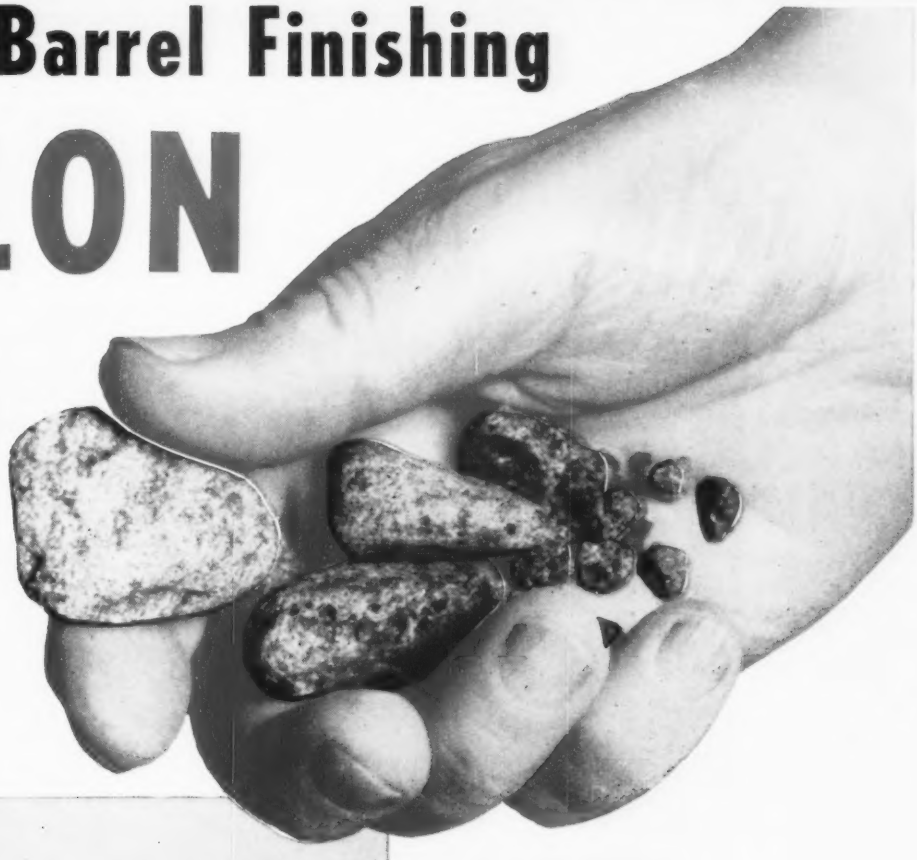
Apothecaries Hall Co.

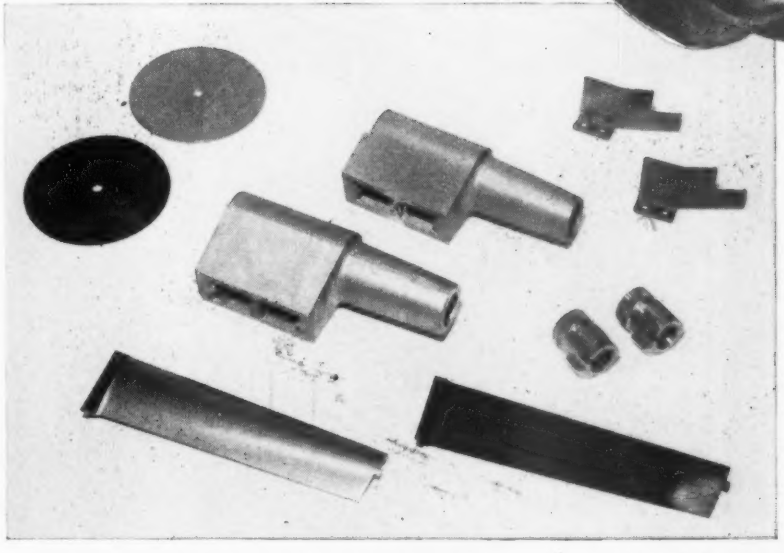
APOTHECARIES HALL COMPANY WATERBURY CONNECTICUT 1849

For Rapid Barrel Finishing

EXOLON

Tumbling Abrasive





Various stamped, die cast, forged and screw machine parts before and after barrel finishing with EXOLON abrasives.

• More and more manufacturers are turning to barrel finishing for its big savings and uniformity over individual hand finishing.

Naturally, the process is only as effective as the abrasive used. In response to the demand for a fast-cutting, long-life abrasive, EXOLON has developed this superhard aluminum oxide grain which is *barrel-finished itself* for non-scratch, precision smoothing of your metal surfaces.

May we barrel-finish some of your sample parts *at no obligation to you?* Or, if you prefer, we are prepared to furnish you trial lots of Exolon Barrel Finishing Abrasive at quantity discount for trial in your own barrel. You will find, as others are finding daily, that it gives you a superior finish at substantially lower cost. Write today!

SINGLE OPERATION ECONOMY

★ **IN CLEANING UP**
★ **IN REMOVING BURRS**
★ **IN REMOVING SCALE**

from:

- forgings
- metal castings
- metal stampings
- machined parts

which can be handled in the barrel.

WRITE TODAY FOR DETAILS including our new fact-filled catalog.

The EXOLON Company

945 East Niagara Street **Tonawanda, N. Y.**

Thorold, Ontario, Canada

***Manufacturers of* SILICON CARBIDE *and* ALUMINUM OXIDE ABRASIVES**

SINGLE-KNOB CONTROL provides easy finger-tip setting adjustments.

NEW G-E Germanium Power Supply for Plating Cuts Your DC Power Costs Three Ways

New germanium unit combines high efficiency, ease of installation, and low maintenance—to save you plating dollars

This new General Electric 1000-amp germanium plater, backed by four years of germanium experience, saves you money three ways:

- No special foundation is needed with these compact, lightweight units. Also, only one side of the unit need be clear. Both of these features help reduce installation time and costs.
- Germanium's inherently high over-all conversion efficiency means reduced power costs.
- Germanium rectifiers do not age, and a minimum of moving parts is used. Thus, maintenance is reduced to a fraction of what it is with other types of conversion equipment. Over three years of continuous life testing at General Electric, and in industry, reveal no significant decrease in efficiency due to aging.

OUTSTANDING FEATURES AVAILABLE in this new germanium plater include: down-draft air cooling, single-knob finger-tip control, and complete control flexibility. In addition, these 1000-amp, 12-volt units offer smooth, stepless control. And hermetically sealed rectifier cells promote long life in corrosive plating-room environments.

G.E.'s down-draft air cooling draws air in horizontally through the front panel, minimizing dust and dirt intake.

Single-knob finger-tip control means simplified adjustment. Also, it eliminates multi-knob fumbling and possible transformer unbalance.

Complete control flexibility permits the addition of automatic control in the future without complete replacement of the manual control.

This new plater is the most recent addition to an experience-proven line of G-E germanium power supplies. To date, over 7000 kilowatts of G-E germanium rectifier power supplies have been put in operation. This is the equivalent of more than 1,000,000 amperes at six volts, the normal plating voltage.

FOR ADDITIONAL INFORMATION on G-E germanium power supplies for plating, contact your nearest authorized G-E plating agent, or write Section 463-12, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

EASE OF INSTALLATION, and the fact that only one side of the rectifier need be clear, helps eliminate layout problems.

NEW LOW PRICES

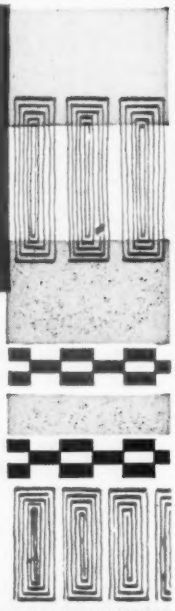
Announcing more good news for plating power supply users. New *low* prices are immediately available on the complete General Electric line of selenium and copper-oxide plating power supplies. G.E. offers you a complete line of plating power supplies to meet practically every plating need.

From MEXICO

. . . and **JOE-D**

Come the Original

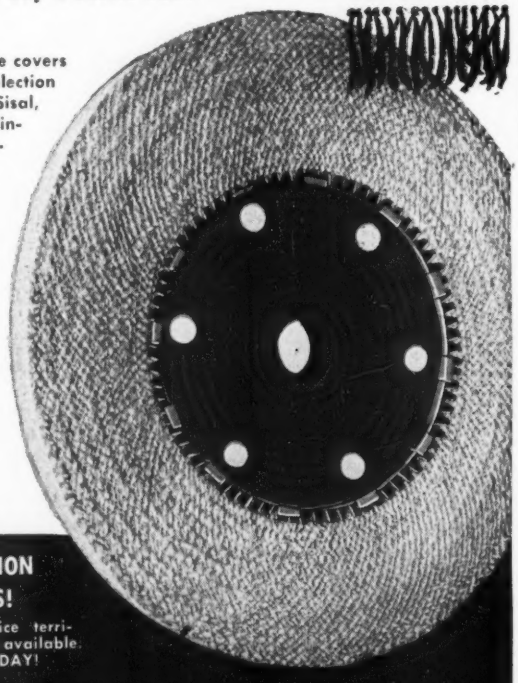
BIAS SISAL BUFFS



GUARANTEED FRAYPROOF PERFORMANCE!

The high-quality sisal used in **every** JOE-D Buff is grown and specially woven for JOE-D in Yucatan, Mexico. Top quality raw material is one reason why JOE-D Sisal Buffs are the finest on the market — fast-cutting, long-lasting. And JOE-D's **original** bias construction guarantees **frayproof** performance — never a loose thread end to scratch or mar. Insist on **original** quality . . . specify JOE-D —you can't buy a better buff!

The JOE-D line covers a complete selection of Bias, Bias Sisal, Bias Spoke (Finger) and Conventional Buffs—as well as quality Polishing Wheels.



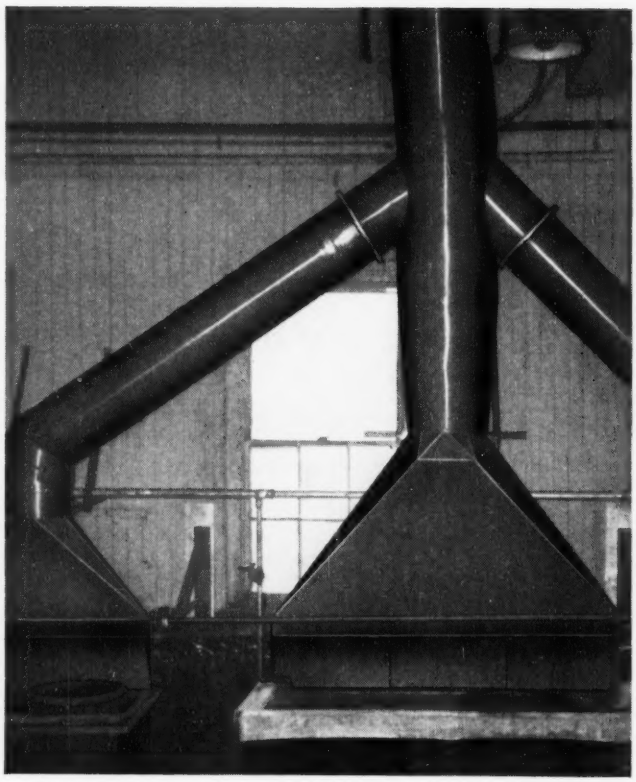
Holders of the original patent on Bias Sisal Buffs— U.S. Pat. No. 2642706

ATTENTION JOBBERS!

Some choice territories still available. WRITE TODAY!

the JOE-D Buff Company

SANDWICH, ILLINOIS • TELEPHONE 2171



Out of many, one material only has successfully eliminated the problem of replacement at this exhaust duct system over corrosive acid fumes at Sargent & Company, New Haven, Conn. That material is Boltaron 6200. Fabricator: New Eng. Rack Co., Hamden, Conn.

CORROSION IS COSTLY...SAVE MONEY WITH *Boltaron* 6200

Here at Sargent & Company, as in so many similar installations across the country, Boltaron 6200 proves once again that corrosion can be licked, replacement eliminated. Perhaps this remarkable unplasticized polyvinyl chloride can help you. Check its many advantages.

Boltaron 6200 is a rigid material, about one-half the weight of aluminum, which may be machined, formed or welded. It is virtually impervious to corrosive gases and liquids, treated and untreated waters, alcohol, alkalies, strong and weak organic or inorganic acids. It has good impact strength and eliminates replacement problems. It is available in sheet, rod, pipe and block stock.

The limitations of Boltaron are few and deal chiefly with strength and temperature conditions. Trained engineers and fabricators throughout the United States and Canada stand ready to discuss Boltaron 6200 with you in relation to your specific problem. You have much to gain by writing now, Box 130, for further details along with the name of the Boltaron representative in your area.

H. N. HARTWELL & SON, INC.

Industrial Plastics Division, Park Square Bldg., Boston, Massachusetts

NEED EXTRA IMPACT STRENGTH? Ask about Boltaron 7200.

DOW. . . *industry's most complete line of chlorinated solvents*

DOW TRICHLOROETHYLENE

when metals and costs must look their best

Fast, thorough removal by vapor degreasing of oils, waxes, greases, chips, tars, resins, lubricants, coolants, other contaminants

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Leaves steel, zinc, brass, copper, aluminum, magnesium, all common industrial alloys clean, bare, dry—ready for reject-free, economical finishing

When you degrease *fast* you save money. When you degrease *thoroughly* and get fewer rejects you save money. When your solvent causes *less cleanout* in the still and degreaser you save money. When your solvent is really stabilized for recovery after *repeated use* you save money.

These points of superiority, and several more, make DOW TRICHLOROETHYLENE the *saving buy* for you. Contact your Dow distributor for your solvent requirements. He's the source for your other specialized solvent needs, too . . . stabilized DOW PERCHLOROETHYLENE and CHLOROTHENE*, the wonderful new *cold* degreaser. For detailed information on any one or all three of these superior solvents, just drop a line to THE DOW CHEMICAL COMPANY, Dept. S 670A, Midland, Michigan.

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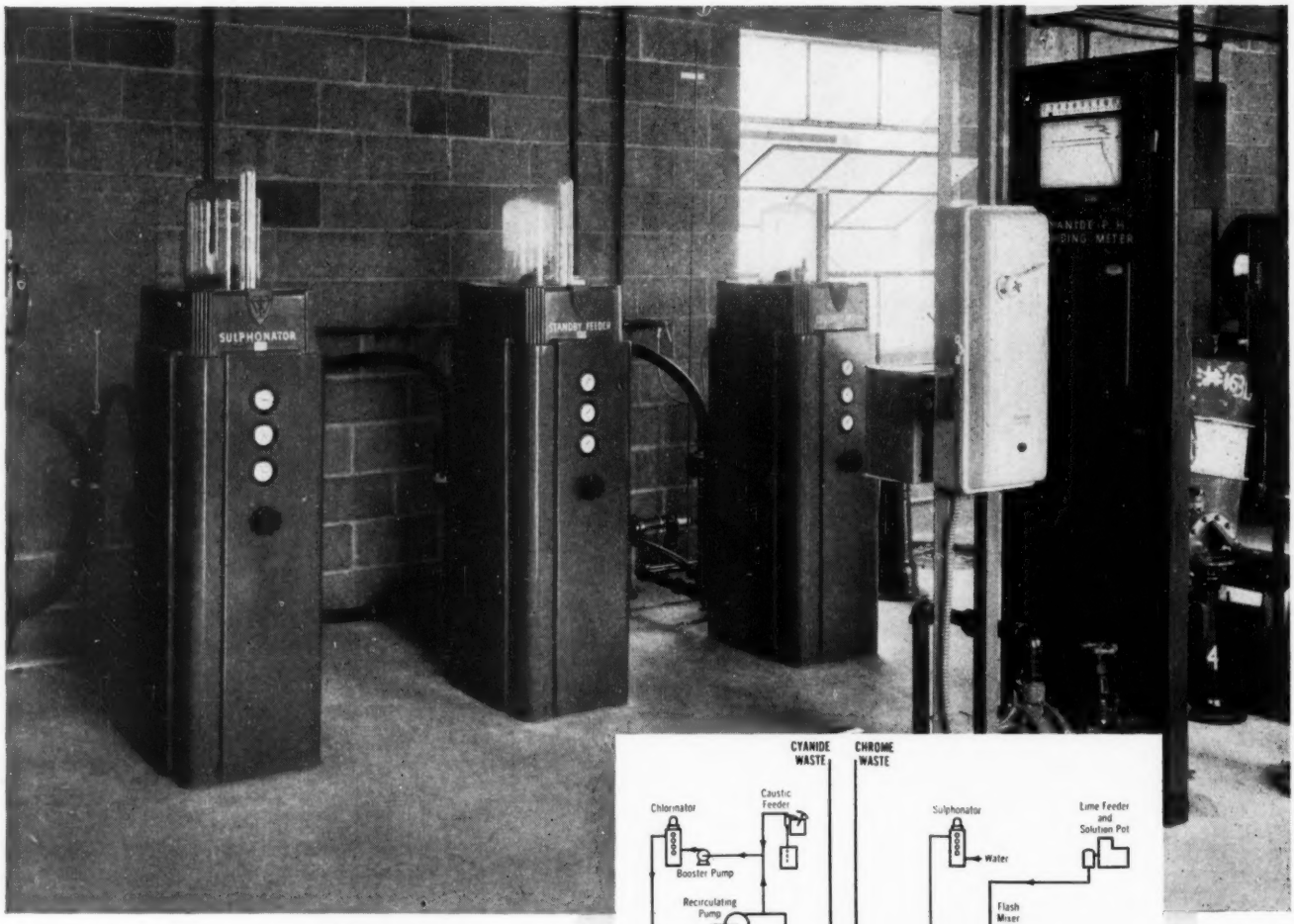
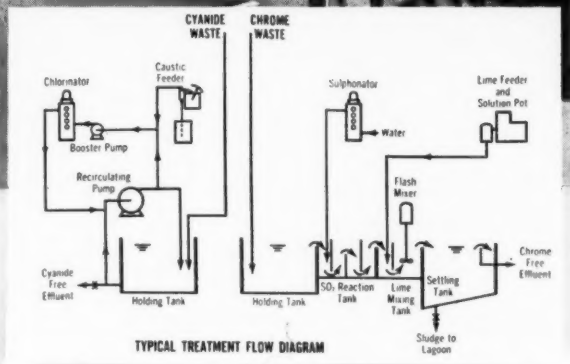
you can depend on DOW SOLVENTS

DOW





TYPICAL TREATMENT FLOW DIAGRAM

DAYSTROM INSTRUMENT DIVISION USES

W&T *Cyanide & Chrome Waste Treatment*

The Daystrom Instrument Division of Daystrom, Incorporated, located at Archbald, Pennsylvania, has provided a compact and efficient treating plant to destroy the toxic components of their plating waste. The treatment plant has been in continuous operation since 1953.

The cyanide bearing waste is treated with chlorine and caustic, using a W&T Water Diaphragm Chlorinator and a W&T Chemical Solution Feeder. The treatment breaks down the cyanide to harmless carbon dioxide and nitrogen gas components.

The chromium bearing waste is treated with sulphur dioxide and lime, using a W&T Sulphonator and a W&T Dry Chemical Feeder. The treatment removes the toxic chromium and other heavy metals from solution, to be disposed of as sludge.

If you would like more information on Wallace & Tiernan cyanide or chromium waste treatment, write for bulletin RA-2120-CM.

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

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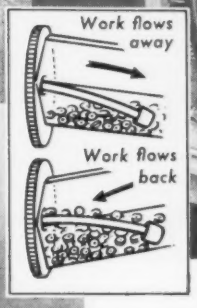
Startling BREATH-TAKING REVOLUTIONARY



Pat. App. SN-510,922.

Model SPXO

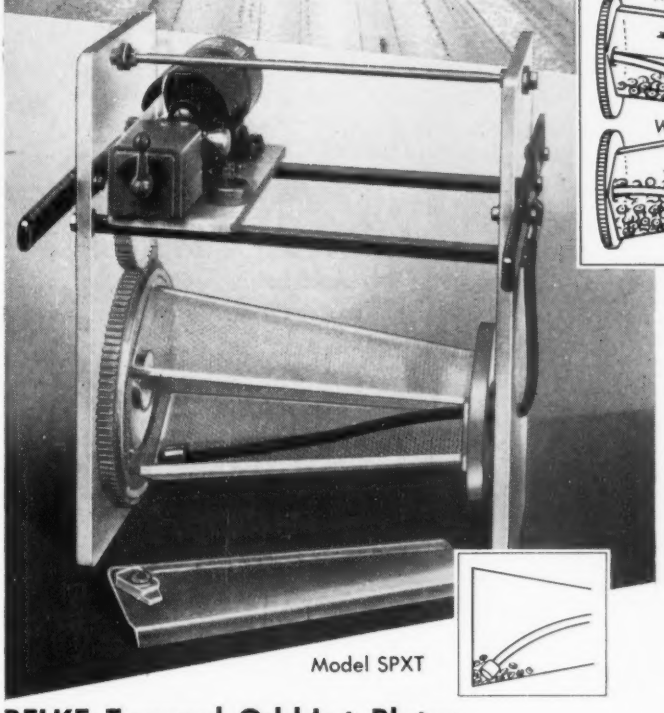
BELKE Double Oscillating Cylinder

Affords uniformity of deposit never before obtainable in barrel plating.

Eccentrically mounted cylinder oscillates as it rotates. Moves the work back and forth *across* the cylinder. No parts remain shielded by cylinder ends. All parts exposed for plating so uniform you can deposit specified thickness in a fraction of the time formerly required.

A tremendous money saver for all barrel plating. An absolute must for washers and flat pieces that tend to stick together.

All sizes from 14 x 30 regulars to 6 x 12 portables.



Model SPXT

BELKE Tapered Odd-Lot Plater

Plates from a few pieces to full capacity

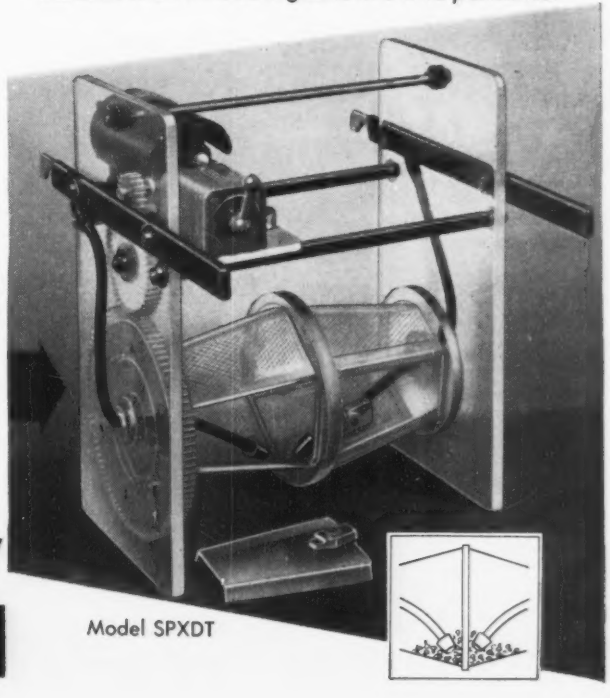
Eliminates costly hand wiring *heretofore unavoidable in plating small quantities.*

Tapered Lucite cylinder *piles the work at the deep end around the ball contact.* Assures uniform plating of any quantity from a few pieces to a full load.

BELKE Double Tapered Odd-Lot Plater

Plates odd lots of two kinds of work.

Double tapered, two-compartment Lucite cylinder piles each kind of work around a ball contact. *Assures uniform plating in each compartment of any quantity from a few pieces to a full load.*



Model SPXDT

The Belke Manufacturing Company
947 N. Cicero Ave., Chicago 51

EVERYTHING FOR PLATING PLANTS

POTASSIUM CYANIDE

98% KCN

for copper and silver plating—

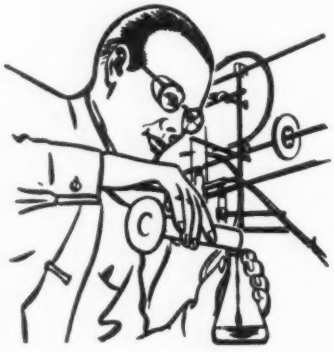
DEPEND ON DU PONT

...High-Purity KCN

IN CONVENIENT, DRY FORM

Du Pont's guaranteed high-purity potassium cyanide is ideal for *all* your copper and silver plating work.

Shipped in full open-head drums, Du Pont's crystalline potassium cyanide is easy to handle and convenient to store.



...A Reliable Supply

FROM DU PONT'S MODERN MEMPHIS PLANT

Du Pont has new production facilities at Memphis, Tenn., to assure you a dependable domestic source for potassium cyanide.

You can always count on fast, national delivery from Du Pont's conveniently located warehouses.

...Technical Service

FROM DU PONT FIELD MEN

Du Pont's potassium cyanide is backed by a practical technical service to help you maintain plating efficiency.

Just call any of the Du Pont district offices listed below for this prompt service.

E. I. du Pont de Nemours & Co. (Inc.) • Electrochemicals Department • Wilmington 98, Del.

DISTRICT OFFICES: Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit
El Monte (Calif.) • Kansas City* • New York • Philadelphia • Export Division, Wilmington, Del.

*Barada & Page, Inc

CHEMICALS • PROCESSES • SERVICE

for ELECTROPLATING

DU PONT

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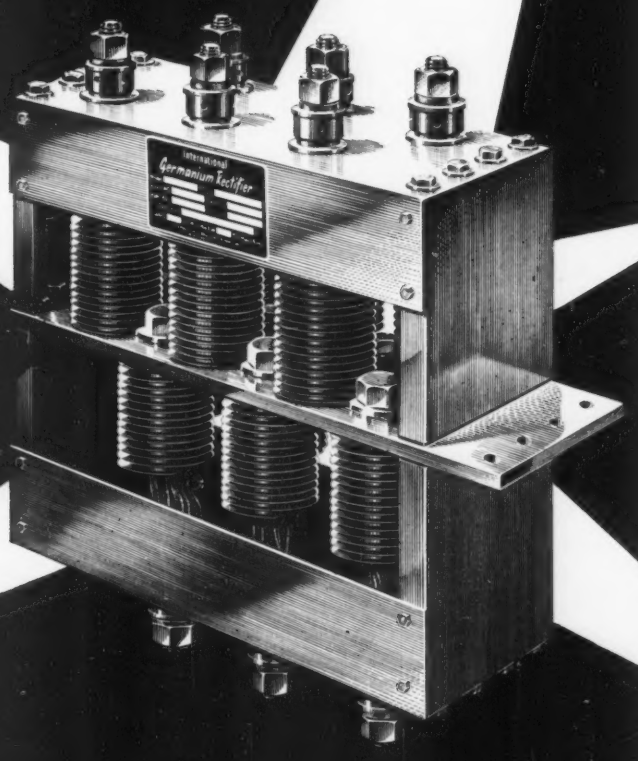
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

International Rectifier Corporation

proudly presents

International germanium power rectifiers!



This new line of
Power Rectifiers features:

- High efficiency . . . up to 97%
- Lowest forward drop
- High reverse to forward ratio
- No reforming required after storage
- Unlimited life expectancy
- Ratings:
  26 to 66 AC input volts per junction
  150 to 100,000 amps DC output

Operating temperature range
−55 C to + 75 C

International Rectifier

CORPORATION

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BEFORE YOU SAY "WE DON'T NEED IT"
LOOK INTO ALL THE ADVANTAGES OF
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← *Check the Information You Desire, Today!*

FOR ZINC PLATING

- ☐ ROHCO 100 BARREL ZINC BRIGHTENER for brilliant deposits, maximum coverage and lowest cost.
- ☐ ROHCO 303 STILL ZINC BRIGHTENER for highest luster zinc, used with or without conversion or bright dips.
- ☐ Perma-Brite BARREL ZINC BRIGHTENER for economical bright zinc plating. Deposits not quite so bluish as ROHCO 100.
- ☐ Perma-Brite STILL ZINC BRIGHTENER outstanding in lowest cost for large volume solutions; stable in the bath, completely soluble — added directly to the tank. The answer to automatic zinc plating. Easily used for conversion or bright dips.
- ☐ ROHCO ZINC PURIFIER to keep baths in tip-top shape.

FOR CADMIUM PLATING

- ☐ ROHCO 20XL (Liquid or Powder) gives brightest cadmium; minimizes cadmium consumption by improving uniformity of deposit.
- ☐ AIRCRAFT BLACK CADMIUM PROCESS for adherent, attractive blackening of cadmium.

FOR CHROMIUM PLATING

- ☐ ROHCO NO-CRO-MIST® the original additive to safeguard worker's health by eliminating chrome fumes, solves ventilating and heating problems; saves chromic acid.
- ☐ CHROMETER — a special hydrometer which gives direct chromic acid content at the bath operating temperature.
- ☐ HULL CELLS AND RECTIFIERS for speedy, positive catalyst control.

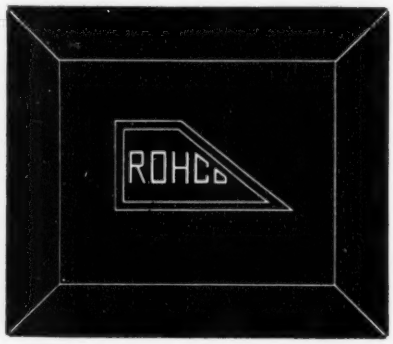
FOR ALL PLATING

- ☐ HULL CELL UNITS of lucite, solid-wall porcelain and molded polythene. New Model "WT" or "WT1000" with immersion heater and built-in thermostat; electric Hull Cell Agitator.
- ☐ HANGING HULL CELL is a novel device for making plating tests under production conditions. Indispensable for checking each operation in a plating cycle.
- ☐ HULL CELL ANODES: cast of various metals.
- ☐ HULL CELL CATHODES: zinc plated steel, No. 3 finish; or polished brass with peelable protective coating.
- ☐ SMALL PLATING RECTIFIERS for Hull Cell Tests and experimental plating: Models B267, B500, B1000, B1500 with capacities ranging from 5 to 50 amperes at adequate voltage for all plating.
- ☐ ROHCO CURRENTESTER enables platers to detect and correct the hidden troubles of rectifiers that ordinary meters don't indicate. New Model C-2, compact, attractively priced.
- ☐ ROHCO RINS-AID sheds water; improves drying; prevents staining.

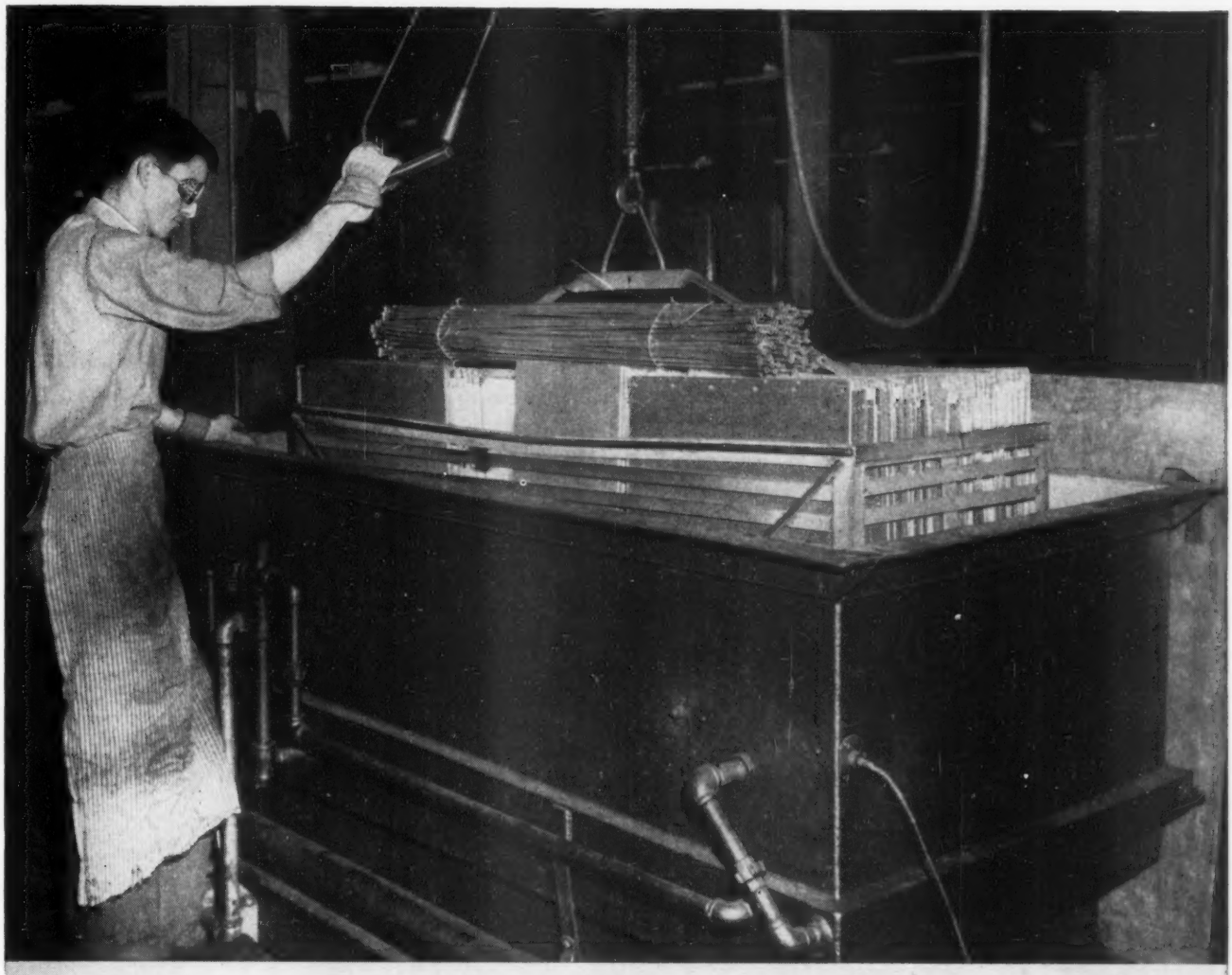
R. O. HULL & COMPANY, Inc.

1303 Parsons Court **Rocky River 16, Ohio**

Canada: Armalite Company, Ltd.
Toronto 6, Canada

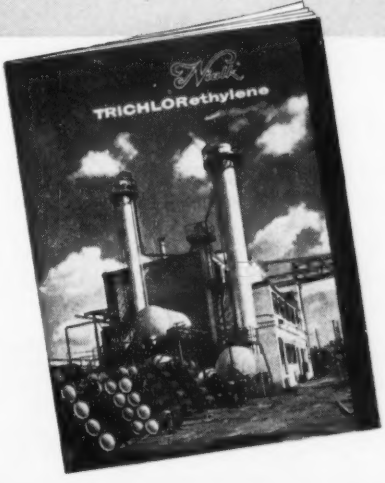


"THE HULL CELL TEST MAKES PLATING BEST"



Want more cleaning at lower cost?

Use Nialk® TRICHLORethylene



Send for free illustrated booklet, NIALK TRICHLORethylene; *contains valuable data on the use and handling of this chemical.*

The high solvent power of NIALK TRICHLORethylene makes it one of the most efficient metal degreasing agents available today. This plus its recoverability for re-use proves it more economical for your cleaning and degreasing processes. Characterized by uniform quality and high chemical stability, this nonflammable solvent may be used in vapor degreasing or as a direct dip rinse.

Choose NIALK TRICHLORethylene for greater cleaning power per gallon.

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Plant: Niagara Falls, N. Y.

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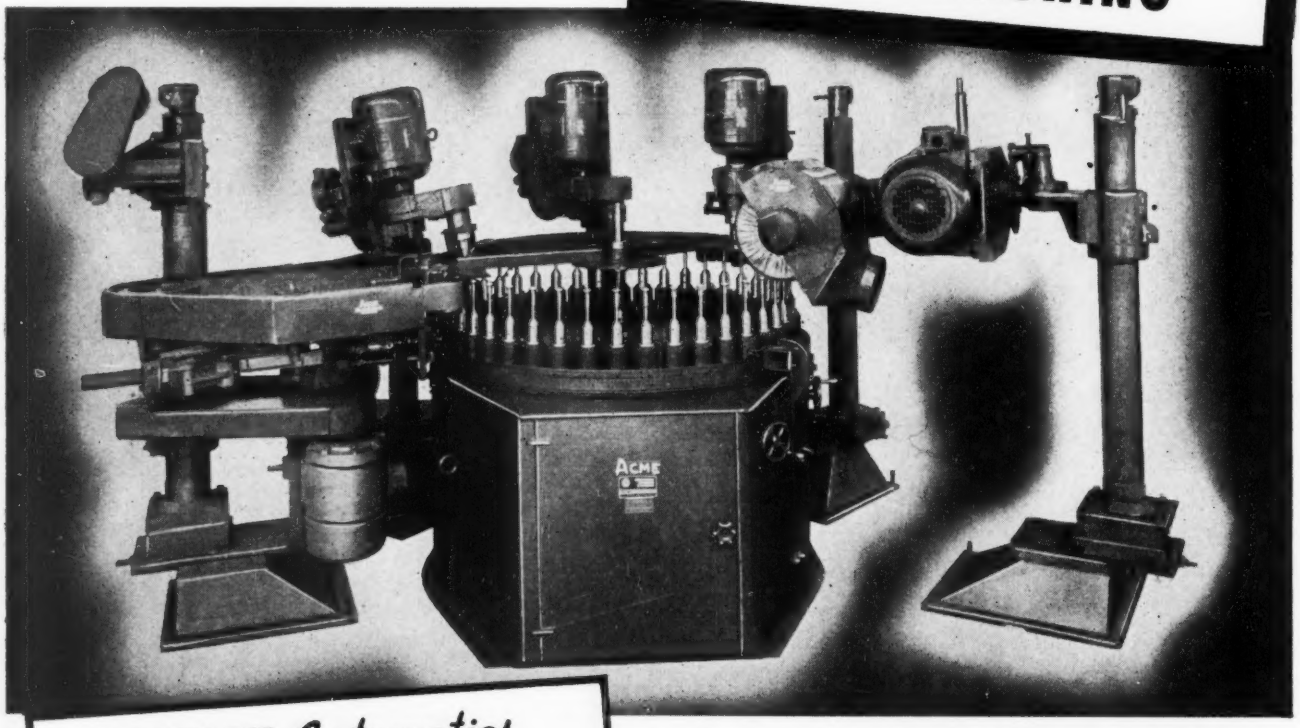

ROTARY *Automatics*
STRAIGHT LINE *Automatics*
SEMI-*Automatics*
Catalogs on Request

Recommendations & Quotations

For recommendations, send blue prints of part or samples before and after finishing operations, together with detailed information on finishing operations and production requirements. If production methods will cut your costs, we can set your job up in our experimental processing department and you can inspect the machines in operation.

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Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 35 YEARS

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Also Black Magic Blackening Processes for other ferrous and non-ferrous metals; metal cleaners, rustproofing oils and waxes, plating specialties and a complete line of heat treating salts.

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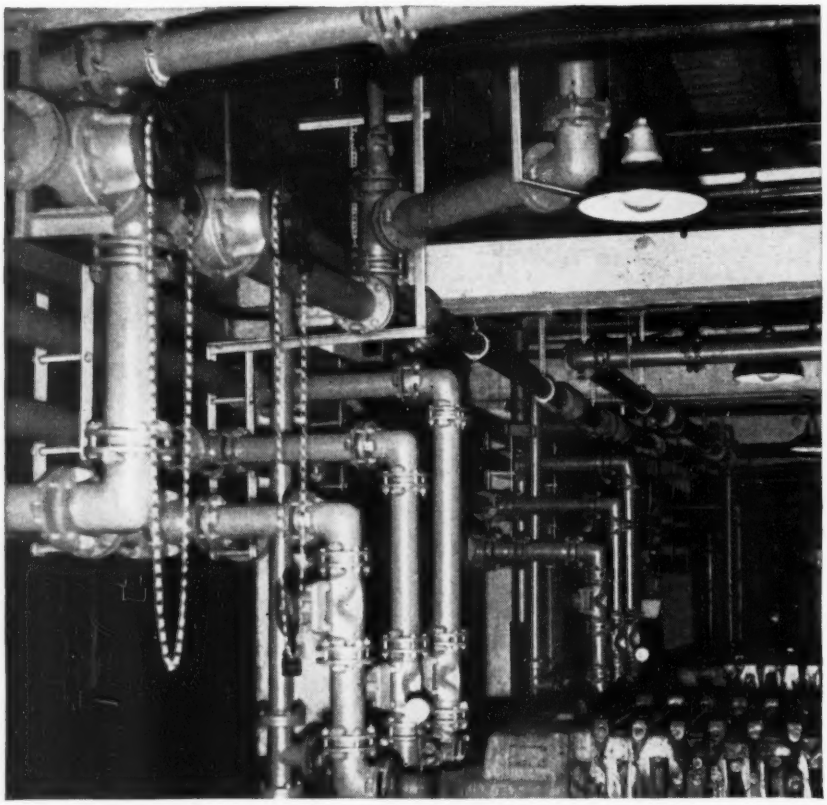
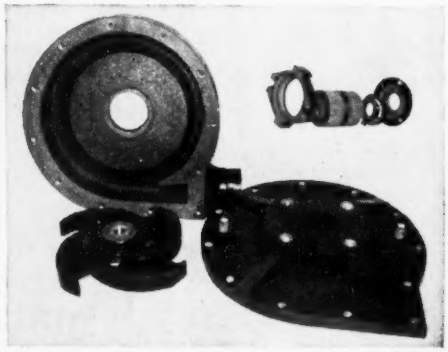
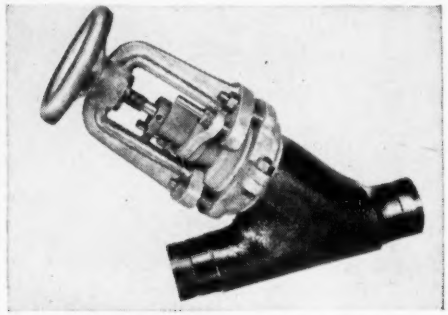
PIPE • DUCT • FITTINGS • VALVES • PUMPS



A typical large installation of Haveg pipe, valves and fittings showing simple method of support required. Haveg pipe is unaffected by thermal shock, seldom requires insulation.



These Haveg parts are used in pumps for hot (104°F.) 30% Hydrochloric acid. Typical record: 33 months without replacing a single part. Many users report even longer life.



Escape potential valve troubles by buying Haveg y-valves and diaphragm valves which are smooth-molded, exactingly machined, tested in the Haveg factory. Haveg works with you on special designs!

Processing Corrosion has been Controlled!

Where liquids get hot and corrosive, it pays to consider all the facts about Haveg piping systems. Haveg has all the major ingredients for good chemical piping. Strength. Durability. Light weight. Outstanding resistance to corrosion and thermal shock.

It withstands rapid temperature changes and enables you to go into a high range of process temperatures with complete safety and a proven history of reliable performance. Haveg piping resists corrosion of practically all acids (except oxidizing acids) and lasts for years without repairs or maintenance.

Haveg *piping* is molded in diameters of ½" up and comes in lengths to 10'. It can be cut and fitted on the job (a new Haveg tool makes this even simpler—ask your Haveg engineer for details). For handling corrosive gases or fumes, Haveg *duct* is made in cylindrical or rectangular shape with lighter walls. Fume hoods, bifurcators, fan housings, fittings, all are made from Haveg and give complete containment and control of corrosives.

It's a long story telling all about Haveg, the moldable, thermosetting plastic material made of acid-digested asbestos and synthetic resins. Haveg is both a material and a service . . . it comes from America's first molders of corrosion-resistant plastic equipment. It can be as big as a 200' stack, as small as a miniature pump part. Call the experienced sales engineer listed. Write for the 64-page illustrated Bulletin F-6 which contains size and chemical resistance charts, design specifications. Remember, Haveg is a logical, proven answer to your design problems in handling hot, corrosive liquids; in fact, in all equipment that must control processing corrosion.

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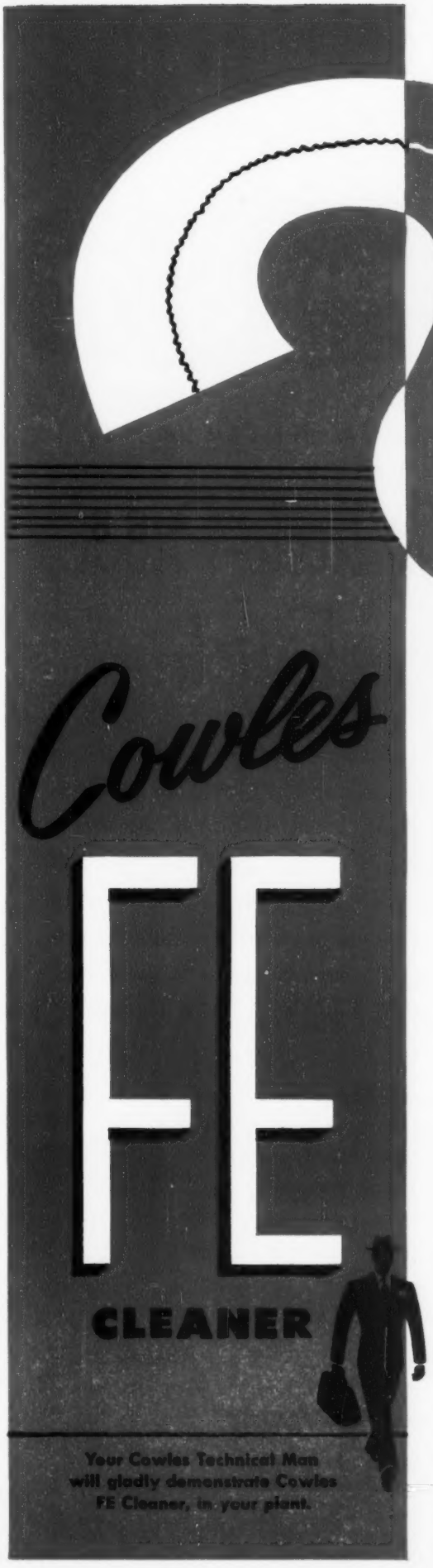

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Your customers will be pleased with the bright, clear finish you get with Cowles FE Cleaner in your electrocleaning tanks.

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You can depend upon Cowles FE Cleaner because it is built for

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- —controlled foaming and longer tank life.

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AT LAST
A CLEANER that does a better job ...and without heat — INTERNATIONAL-504

Remove shop dirt, oil, grime and compounds from metal quickly . . . and completely at room temperatures. That in brief is the story of International-504, the new amazingly efficient cold cleaner for washing machine use.

International-504 is a blend of specially compounded detergents, wetting agents, high-solvency-power naphthas and solvents that literally dissolves dirt. When left on the work after cleaning, International-504 provides an excellent, temporary rustproofing film.

In terms of lower cleaning costs and more effective results, it will pay you to get the facts about International-504—the superior cold cleaner.

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For valuable data on other properties and applications of RHODIUM PLATE, write for free detailed booklet.

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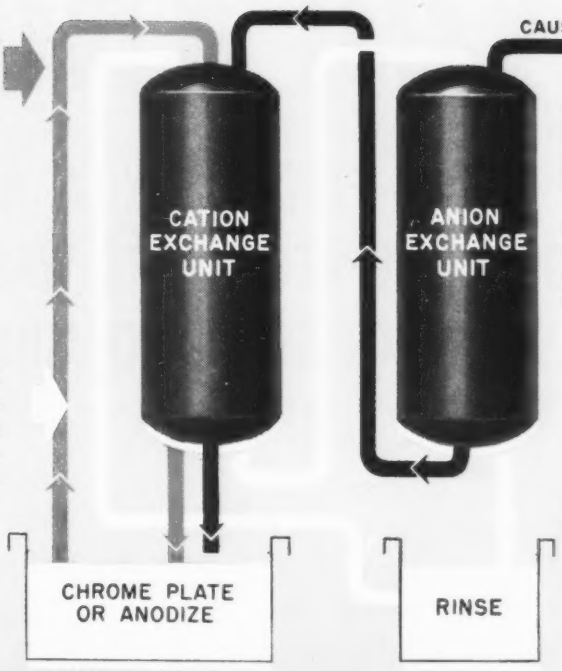
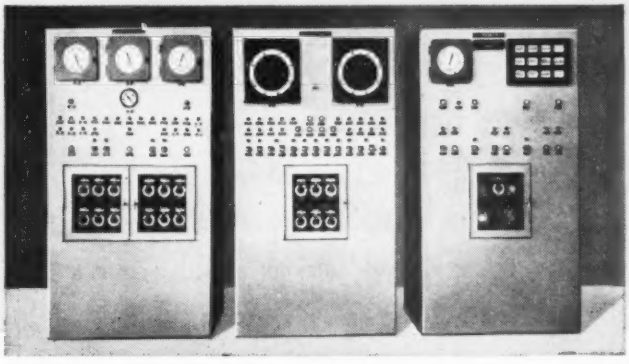
RENEWS PLATING BATH. This cycle removes aluminum, copper, iron and other impurities . . . allows continued re-use of bath . . . eliminates disposal problem. Compared with the usual toxic-waste disposal equipment, ion exchange saves up to 50% on initial costs, 75% on operating costs, 80% on floor space.

RENEWS RINSE WATER. Cation unit removes metallic impurities . . . anion unit removes chromic acid . . . allowing continued reuse of rinse water. Cuts consumption 90%!



RECLAIMS CHROMATE. This cycle picks up chromic acid removed from the rinse water and returns it to the plating bath. Chromate saved in the plating bath and rinse water often pays for the entire ion exchange installation!

SAVINGS FOR SMALL PLANTS. Ion exchange economies apply to small plating plants as well as large.



AUTOMATIC CONTROLS for ion exchangers in an auto parts plating plant. These controls simplify operation. No specially trained operators or technicians required.

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Ion Exchange Cuts Plating Costs

Modern ion exchange equipment really pays off for plating plants. Here's why:

Faster production. Dip periods are shorter, and there's no down-time for dumping because baths are always at full strength. Time savings are biggest for bright-dipping, anodizing, etching, stripping.

Better quality. Clean baths produce more uniform plating deposits. Clean rinses prevent water stains and spots.

Lower operating costs. Contaminant-free baths use less current. The improved quality means fewer rejects . . . and reduced polishing and wiping costs.

A large aircraft manufacturer saved $10,000 on anodizing in the first year with ion exchange. A leading auto maker prevented a stream pollution shut-down, improved quality, reduced costs . . . and uses the same ion exchange equipment for treating other process water in the plant!

Largest manufacturer of ion exchange equipment, The Permutit Company, is the only firm that offers a complete ion exchange service: rinse water or bath analysis, engineering, equipment, ion exchange resins and automatic controls . . . *all from one source.*

For details, write: The Permutit Company, Dept. MF-9, 330 West 42nd St., New York 36, N. Y.

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ION EXCHANGE

for Water Conditioning • Chemical Processing

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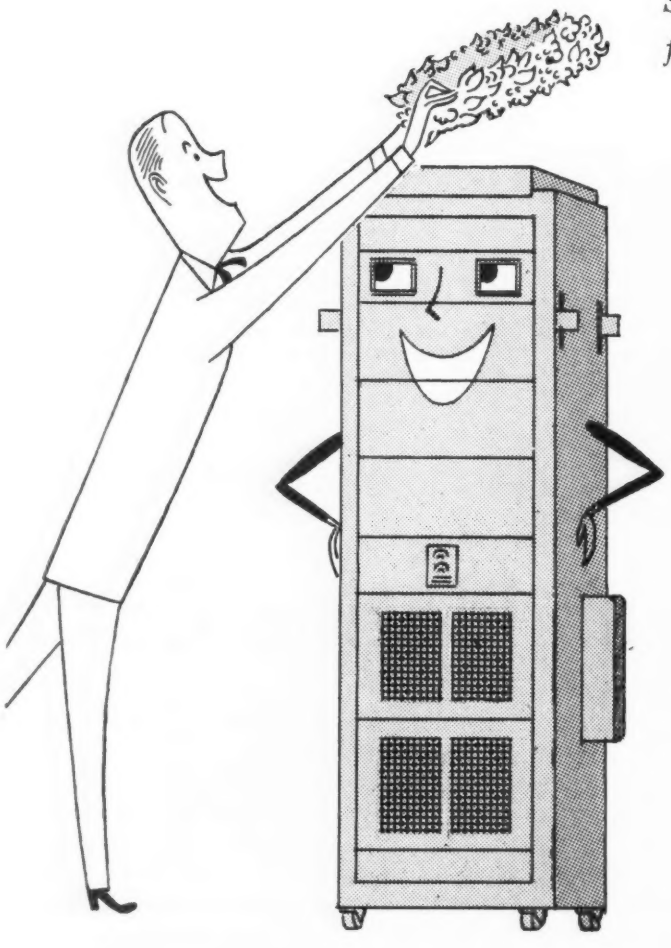
NEARLY EVERY FEATURE NOW AVAILABLE ON ELECTROPLATING RECTIFIERS WAS ORIGINATED BY GREEN ELECTRIC — AND MOST OF THESE OVER A DOZEN YEARS AGO



Some of the standard and special features in Munning-Green Rectifiers:

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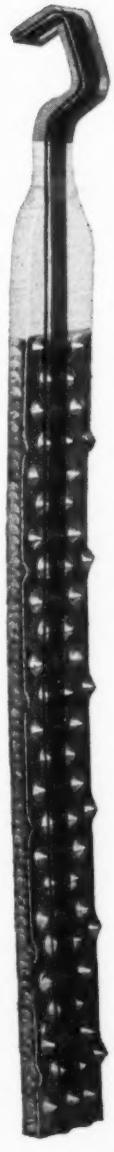
GUARANTEED FOR 18 MONTHS

World's Finest Anode for Chromium Plating



You can't lose when you use "Copper Core" Anodes – The World's Finest Anode for Chrome Plating . . . because you get an actual DOLLAR AND CENTS GUARANTEE.

The conditions of this unusual guarantee are clear and simple:

A. For every month that our "Copper Core" Anode falls short of 18 months of top quality service, it can be exchanged for a new "Copper Core" Anode on an adjusted or pro rata life basis.
B. All the anodes in the tank must be Tramer "Copper Core" Anodes.
C. They may not be used in proprietary solutions.
D. The unsatisfactory anodes must be returned to us for credit on new "Copper Core" Anodes.

The "Copper Core" is homogeneously bonded to the lead for its entire length. The hook is lead-covered for additional protection.

This remarkable anode will conduct 250 amperes based on copper area alone. Natural current flow makes the entire surface self-cleaning, insuring complete saturation, instant distribution of current, and unusual throwing power. This greatly reduces plating time for a given thickness of deposit.

"Copper Core" distributes current equally throughout the length of the anode. The anode is insulated above and below the solution level; this prevents flow of heavy surface currents and burning off at solution line. Conductivity is uniform at all solution levels, regulated only by the cathode depth.

"Copper Core" Anodes, because of the perfect contact maintained by a one-piece copper hook, will not heat at point of contact, and there are no current failures to solution. "Copper Core" Anodes do not warp out of shape.

Write today for prices (NOW CUT AS MUCH AS 30%), and when writing tell us the length and number of anodes required, also the tin-lead percentage.

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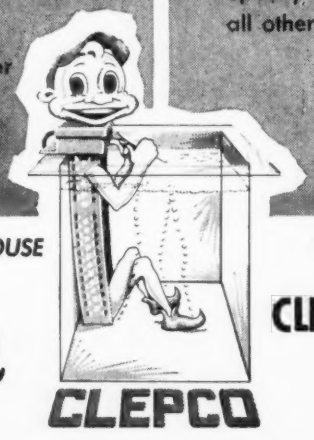
All leading Plating Supply Houses can furnish from stock.



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For quality control and acceptance tests, measure thickness of coatings on metals the easy, accurate, non-destructive way, with the . . .

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Widely used by industry and government for accurately measuring the thickness of:

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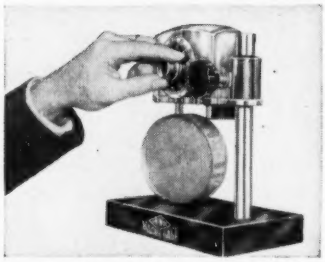
2. Nickel coatings on magnetic or non-magnetic base metals.

Measures coatings on plane, convex or concave surfaces. Gives speedy and accurate results. Easy to use by non-technical personnel.

Avoids expensive rejections due to coatings that may be too thin, or non-uniform. Eliminates the expense involved in replating or discarding specimens spoiled by destructive tests . . . every piece tested is unharmed and ready for use or shipment. Saves materials wasted by coatings thicker than necessary. Its use leads to the discovery of faults that may exist in plating methods or equipment.

Write for Bulletin 2253-G



Coating on cylindrical object being measured with Magne-Gage

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AMERICAN INSTRUMENT COMPANY, INC.

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"Our Reflector Finishing Costs Dropped from $4.00 each to 95¢ each

WHEN WE CHANGED FROM ELECTRO-PLATING TO VACUUM COATING"

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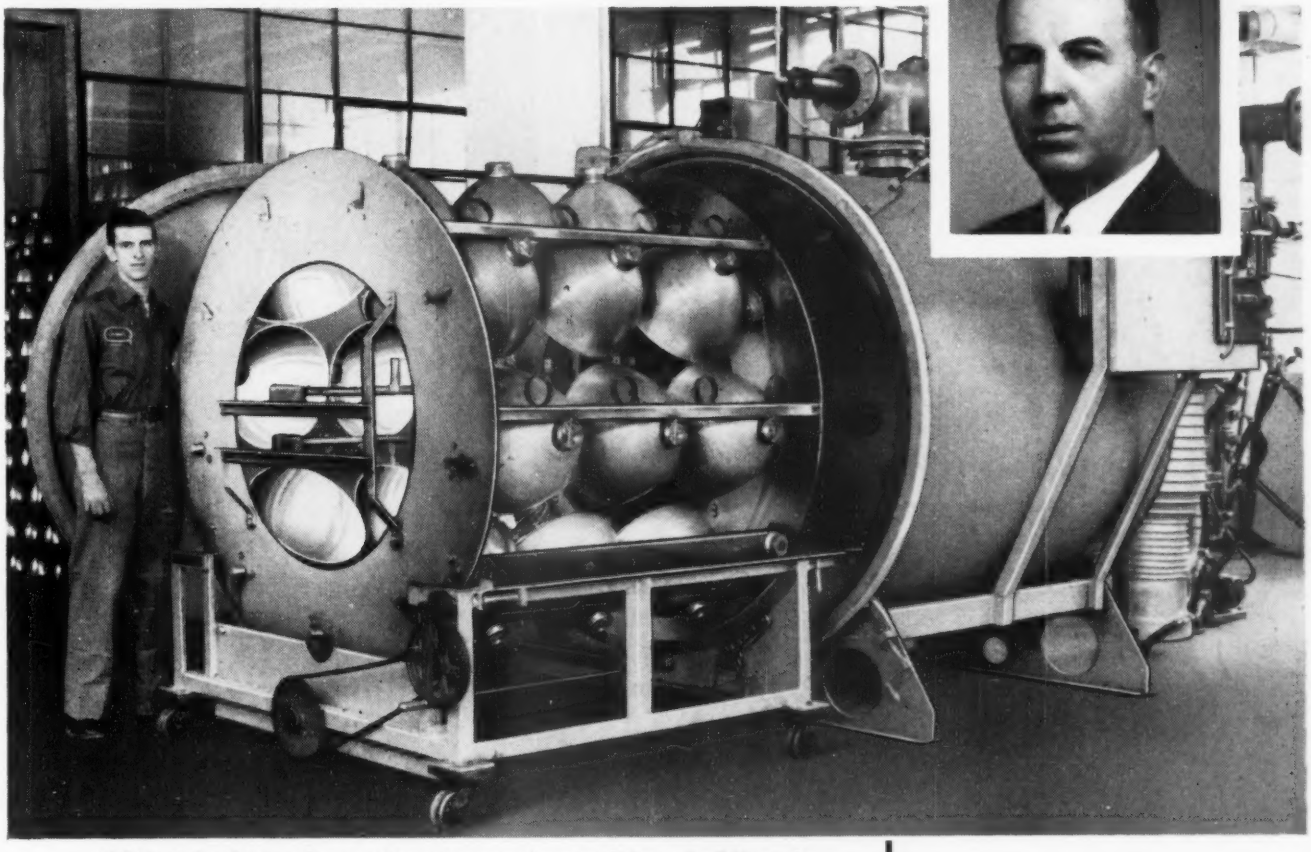

NRC "Rapid Cycle" Vacuum Coater used to produce a new lower cost, higher quality finish on enlarger reflectors by Elwood Pattern Works, Inc., one of the country's leading photo enlarger manufacturer.

Other comments made by Mr. Rogers about the benefits resulting from his NRC "Rapid Cycle" Vacuum Coater:

"Customers are enthusiastic" . . .

". . . has eliminated all our troubles".

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"Our figures show this unit repays its total initial cost in less than 5 months".

You'll find NRC Vacuum Coaters have other important production advantages. They are easier to load . . . safeguarded from operator errors . . . faster to operate . . . less costly to maintain.

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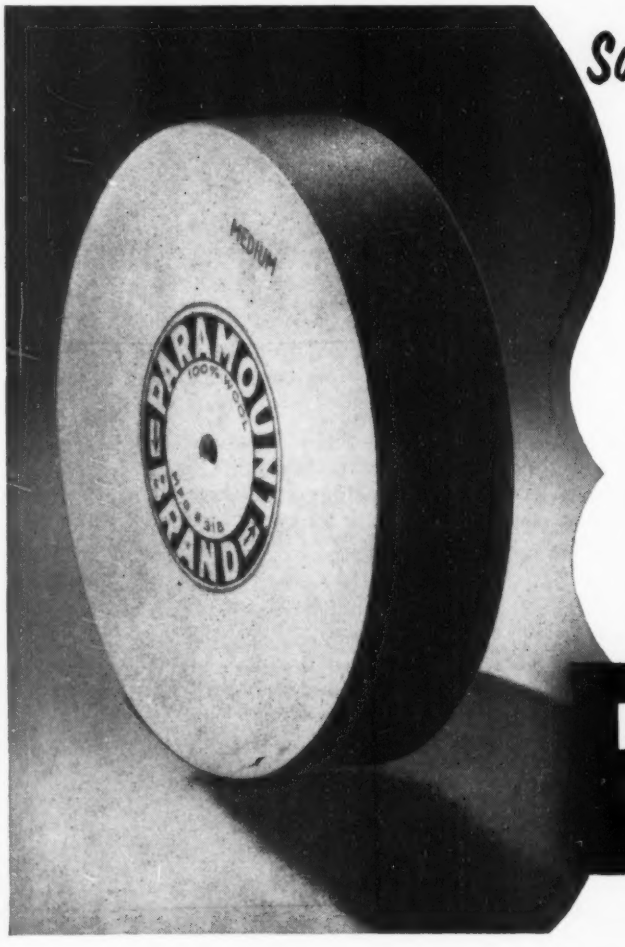

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Whether you work with metals as soft as aluminum or as hard as steel, it's 20 to 1 your polishing applications call for abrasive grains in the 120-240 range. It's here that eye-appealing finishes are born — and it's the very range where Paramount Felt Wheels set up with the proper abrasive can do the most for you — both quality- and cost-wise.

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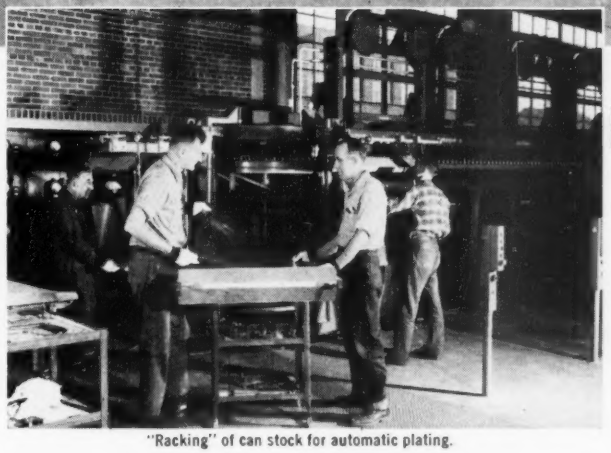
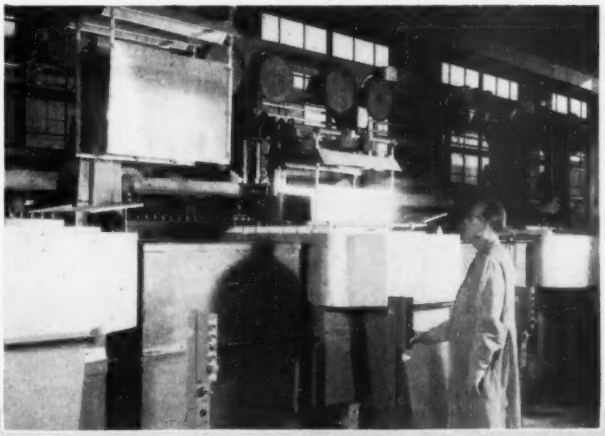


"Racking" of can stock for automatic plating.

Control operator monitoring plating operation at rinse stage.



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LASALCO, INC.

For International Nickel Co. Bayonne, N. J.

For the first time this exclusive installation makes possible the testing of new plating processes and metallic coatings under conditions similar to those in actual plating plants. Fully automatic, this precision-controlled plating line can produce metal-coated test panels in large numbers with positive accuracy for forecasting results obtainable with any experimental or plating method.

Extreme flexibility is an outstanding feature. Thirteen different stations make possible cycle combinations from 1 to 13 stations with times of 5 seconds to several hours, even days, in any station. Also provides either single or double line operation for work up to 3 feet in cross section. Tanks can be simply moved in any sequence with a lift truck. A panel board controls time, current and voltage for each stage of a cycle. Power is supplied by a bank of 6 rectifiers, each rated 1000 amps at 12 volts, 2000 amps at 6 volts. Although designed for full automation, the line can be operated manually.

Again Lasalco demonstrates superior ability to find the *right* answer to *any* plating problem. Make it a rule to *always consult Lasalco first!*

Photos courtesy International Nickel Co., Inc.

HOME OFFICE
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LASALCO, INC.

EQUIPMENT, CHEMICALS AND SUPPLIES FOR ELECTROPLATING, ANODIZING AND POLISHING

IN TEXAS
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SISAL #544-RD

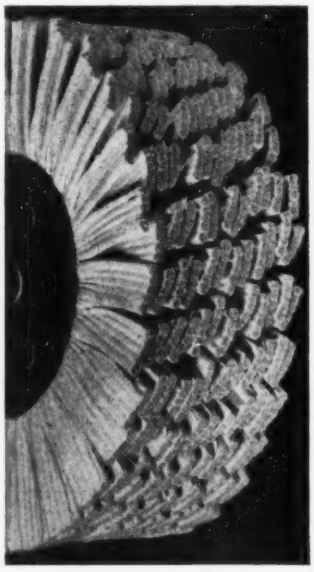
Churchill Finger-Buff*

Especially Developed for

FAST, RUGGED ACTION

on all

HEAVY DUTY OPERATIONS



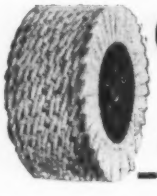
TWO NEW SPECIAL FEATURES

Improved construction of the new sisal type No. 544-RD Churchill Finger-buff* provides new, effective cutting action . . . particularly adapted to perform the heaviest of buffing operations.

Made from the same high quality, super-twisted sisal twine as other popular Churchill sisal wheels, construction of this No. 544-RD provides a wheel in which groups of the sisal twine contained in each finger are combined to form individual units which add strength and rigidity to each finger. In addition, extra sewing on each finger aids in the maintenance of each unit under severe usage.

Actual production tests on this wheel prove that the new construction greatly increases the life and cutting power of this extra heavy-duty Churchill Sisal wheel type No. 544-RD.

- Churchill Finger-Buffs* are competitively priced. Produced in all sizes from 6" to 18" diameters. For complete information write your problem.



Geo. R. Churchill Co., INC.

CHURCHILL FINGER BUFFS*

*Trade Mark Reg. U. S. Pat. Off.

REPRESENTATIVES IN PRINCIPAL CITIES

FREE Catalog

Geo. R. Churchill Co., Inc., Hingham, Mass., Dept. MF
Please send me FREE catalog and complete information.

- My special buffing problem is.....

Name..... Title.....

Firm .....

Street .....

City..... Zone..... State.....

HEAVY PRODUCTION
BACKSTAND IDLERS

Universal Model—
Sets on floor; mounts on wall or ceiling.

Features of BELT MASTER BACKSTAND IDLERS

- *Increased production*—Tracking and belt tension controlled from operating position.
- Saves Belts—Tracking adjustment moves idler pulley from side to side instead of turning the face—avoids twisting and stretching to break the bond.
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- Grease-packed heavy duty Seal Master ball bearings.
- **Proved on the Heaviest of Heavy production lines.**

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keeps belt level

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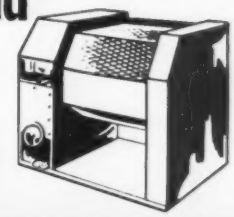
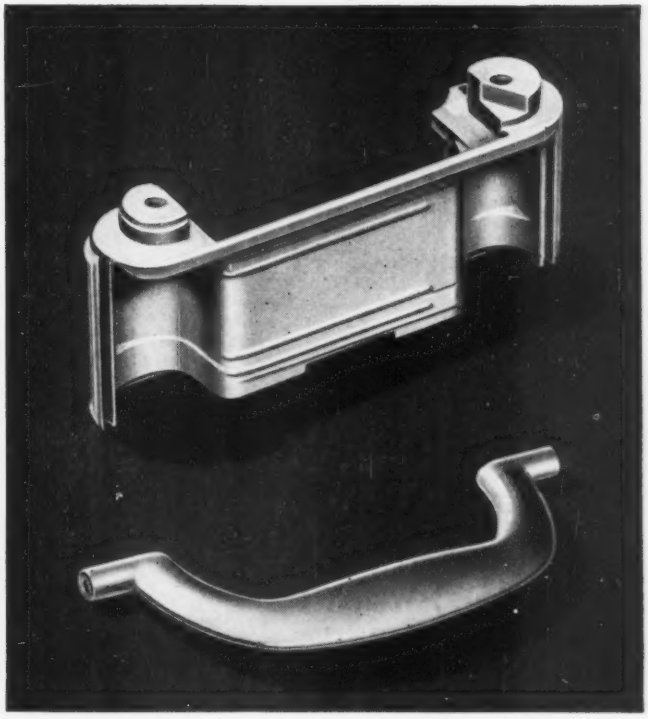
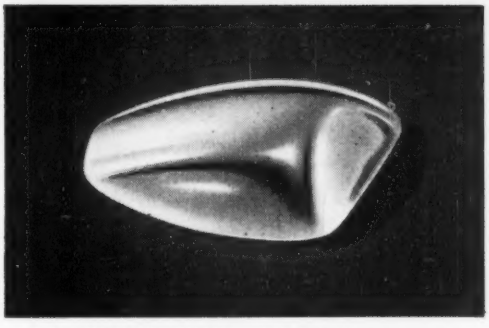
PRODUCT OF
3M
RESEARCH

New HONITE "Micro Cut" Compound gives super smooth finishes on zinc and aluminum die castings!







Use HONITE "Micro Cut" Compound for Mirror Finish on Stainless Steel

On stainless, new "Micro Cut" Compound mirror finishes without darkening, preserving the metal's bright natural color. Impingement control prevents scratches and nicks—corner break is generated with NO dimension change.

Yes, now you can put a super smooth finish on zinc or aluminum die castings. New HONITE Brand "Micro Cut" Compound contains a brand-new, superfine, natural abrasive (exclusive with HONITE) which assures a smooth finish on every die casting. And HONITE "Micro Cut" Compound can cut the "extra steps" from your barrel finishing operation, too. You can eliminate extra rinsing . . . extra coloring . . . extra labor!

HERE'S HOW! On zinc or aluminum die castings, HONITE "Micro Cut" Compound gently and quickly polishes out surface imperfections without "skinning" or exposing porosity—*and* reduces impingement or nicking, because it holds the parts firmly in the chip mass during the run. You get a quality surface for quality plating on zinc die castings . . . a super smooth surface on aluminum die castings . . . with no need for extra rinsing or coloring!

Write today for a demonstration in your plant of HONITE "Micro Cut" Compound.

Honite BRAND

MINNESOTA MINING & MFG. CO.
DEPT. DL 95, ST. PAUL 6, MINN.

☐ Yes, I'd like a demonstration of HONITE "Micro Cut" Compound.

☐ Send me free copy of booklet: "Facts and Figures Report on HONITE Barrel Finishing", which contains complete information about HONITE barrel finishing compounds.

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Company.....

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City.....Zone.....State.....

Made in U.S.A. by Minnesota Mining and Mfg. Co. General Offices: St. Paul 6, Minn. In Canada: P.O. Box 757, London, Ontario. Export Sales Office: 99 Park Avenue, New York City. Makers of "SCOTCH" Brand Pressure-Sensitive Tapes, "SCOTCH" Brand Magnetic Tape, "3M" Adhesives, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing.

FOR BETTER CORROSION RESISTANCE

Iolyte TANKS

Fabricated to your Specifications

●

NO MOLDS NEEDED—Made any size, any shape, at no extra cost and no loss of delivery time.

UNIFORM DIMENSIONS — NO TAPERING — Dimensions are same at bottom and top . . . means larger capacities than tapered molded tanks.

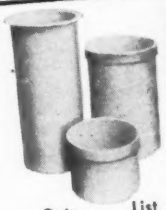
FLANGES, DAMS, Etc. — Can be inexpensively equipped with flanged connection, holes, overflow dams, baffles, separations, etc.

CHEMICALLY RESISTANT THROUGHOUT — Fabricated from *Iolyte* sheet properly reinforced. This is a structural material . . . not a lining.

Write for literature, prices, and table of chemical resistance for Iolyte tanks, crocks, ducts.

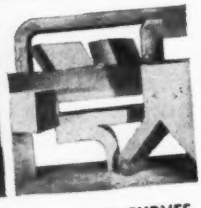
Iolyte CROCKS

Available from Stock



PRICE LIST

Gal. Cap.	Outs. Diam.	Outs. Hght.	List Cost	Gal. Cap.	Outs. Diam.	Outs. Hght.	List Cost
5	9″	18″	18.00	14	18″	12″	35.00
5	10″	15″	18.00	20	18″	18″	40.00
8	12″	16″	22.00	26	18″	24″	45.00
10	12″	20″	24.00	30	18″	28″	49.00
12	12″	24″	26.00	40	18″	36″	59.00
9	10″	24″	23.00	50	18″	48″	69.00
7	9″	24″	21.00	27	22″	18″	49.00
10	16″	12″	26.00	30	22″	20″	53.00
12	16″	14″	28.00	55	22″	36″	70.00
15	16″	18″	33.00	73	22″	48″	83.00
20	16″	24″	40.00	55	28″	22″	76.00
30	16″	36″	49.00	95	28″	36″	98.00
40	16″	48″	59.00	125	28″	48″	125.00



Iolyte DUCTS

ANY DIMENSIONS ANY CURVES ANY LENGTHS

Iolyte has greater resistance to chemical attack than stainless, Monel, or aluminum. 1/5 the weight of steel, it is superior in tension, flexural, and compression strength. Unlike thermoplastics *Iolyte* will not heat-distort below 350 deg.

Send drawings or prints for quotes and ask for literature giving chemical resistances.

Order from us or your distributor. Unless rated firm, payment with order. No COD's.

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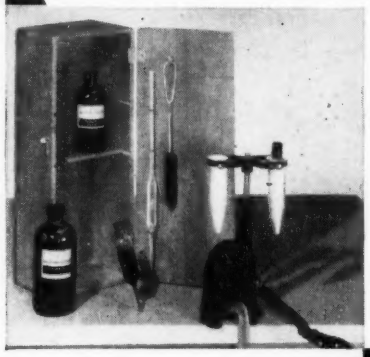
INCREASE YOUR PRODUCTION WITH KOCOUR PLATING TEST EQUIPMENT

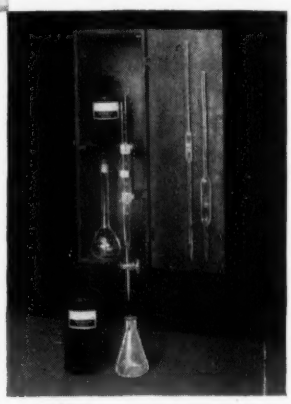


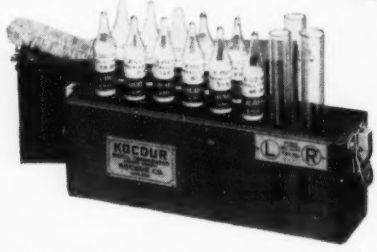
All successful platers know that using KOCOUR plating test equipment means better plating, more production, lower costs, increased profits.

● The KOCOUR Sulfate Test Set enables anyone to accurately and quickly determine the sulfate content of a chromium plating bath in order to maintain a constant check on the ratio of sulfates to chromic acid. . . . This is important to insure consistently good plating results. . . . The entire test takes about 7 minutes . . . no calculations are necessary.

● The KOCOUR Chromic Acid Test Set was designed to accurately and simply determine the chromic acid content of chromium solutions. While a hydrometer is sometimes used for this determination, if close control is desired, the solution should be analyzed.

The set is self-contained . . . reads directly . . . is accurate to the one-half ounce per gallon of chromic acid . . . one simple subtraction is the only necessary calculation.





● Many platers use the KOCOUR Set "CR" for determining trivalent chromium in chromium solutions. The importance of this set is that a chromium solution high or low in trivalent chromium is not only expensive to operate but also is the cause of much spoiled work. The set is simple to operate . . . cost of upkeep small . . . no calculations are necessary.

● KOCOUR are specialists and pioneers in testing equipment for controlling plating — cleaning — pickling — anodizing — and hardening processes . . . special sets can be provided for your requirements.

Write today for further information—no cost or obligation.

KOCOUR COMPANY

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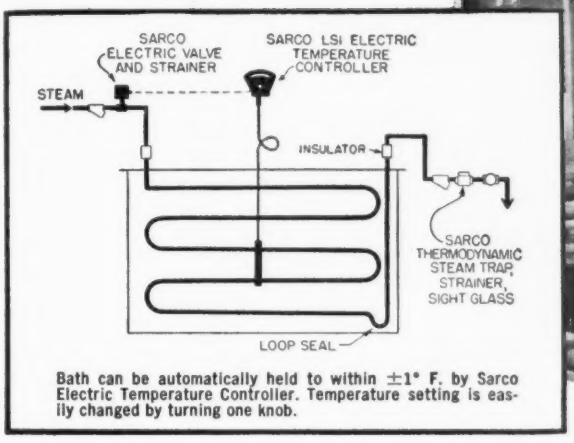
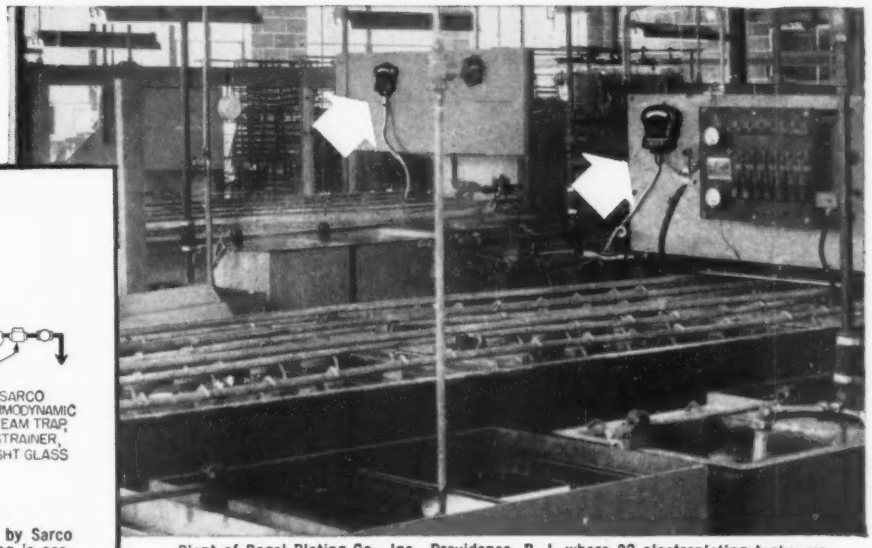
Specify KOCOUR test sets from your supplier



Bath can be automatically held to within ±1° F. by Sarco Electric Temperature Controller. Temperature setting is easily changed by turning one knob.



Plant of Regal Plating Co., Inc., Providence, R. I. where 32 electroplating tanks are equipped with Sarco LSI Electric Indicating Temperature Controllers. Electroplating tanks: gold, hot nickel, silver, rhodium, and copper.

How low-cost Temperature Control ended "blue haze," pitting, burning

Regal Plating Co. now gets high quality plating with minimum of rejects

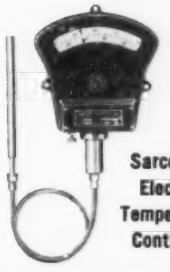
This well-known job plater specializes in high quality plating of costume jewelry and fishing lures. During an expansion program management ordered the elimination of these common plating difficulties: blue haze on nickel plate, pitting of copper plate and burning of sharp points.

These troubles were due to creeping bath temperatures...the result of *manual* temperature control, which is always unreliable.

To solve these problems and step up efficiency, Regal installed Sarco LSI Electric Indicating Temperature Controllers on all 32 plating tanks. Result: above troubles completely eliminated, rejects greatly reduced, no more burnishing of nickel plate.

Sarco Automatic Temperature Control is surprisingly low in cost, simple, accurate, dependable. It pays for itself by lowering rejects, improving plating quality, and preventing waste of expensive solutions.

Investigate the advantages of Sarco Temperature Controllers. Write for Handbook No. 6 or consult your Plating Supplies Jobber. Sarco Company, Inc., Empire State Building, New York 1, N. Y. Representatives in principal cities.



Sarco LSI Electric Temperature Controller

A COMPLETE SYSTEM FOR AS LITTLE AS $130 A TANK!

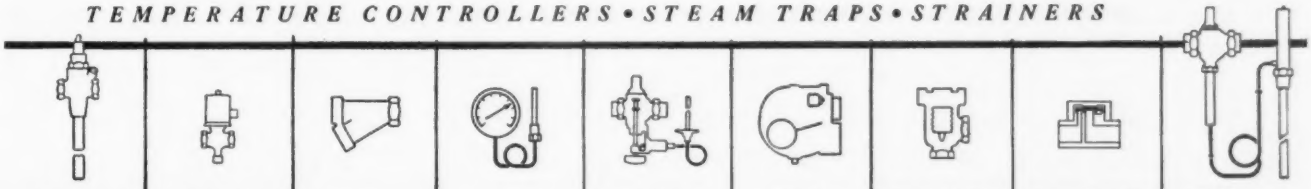
Think of it...automatic temperature control *that often pays for itself in weeks!*

Accurate to plus-minus 1° F. Simple. Dependable. Easily installed.

Easy-to-read controller dial clearly indicates temperature being maintained. Temperature setting quickly changed by turning one knob. 2124-B

SARCO *improves product quality and output*

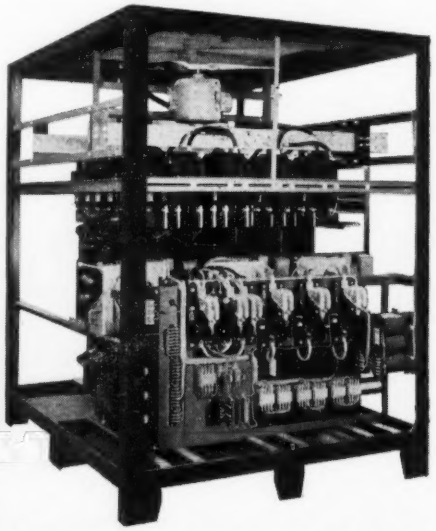
TEMPERATURE CONTROLLERS • STEAM TRAPS • STRAINERS



Self-operated Cooling Controls | Electric Valves (solenoid) | Strainers | Dial Thermometers | Degreaser Vapor Line & Safety Controls | Float-Thermostatic Steam Traps | Thermostatic Steam Traps | Thermodynamic Steam Traps | Self-Operated Temp. Reg.

Accurate Diagnosis . . . Proper Prescription . . .

When a rectifier "case" comes to Richardson-Allen, top flight engineers confer and diagnose the problem with the thoroughness of leading physicians. The proper rectifier is prescribed and then custom made at production prices to suit your own particular needs. Individualized service keynotes Richardson-Allen's custom relationship . . . manufacturers of the finest in rectifiers—selenium, germanium, etc. Write today for complete information.



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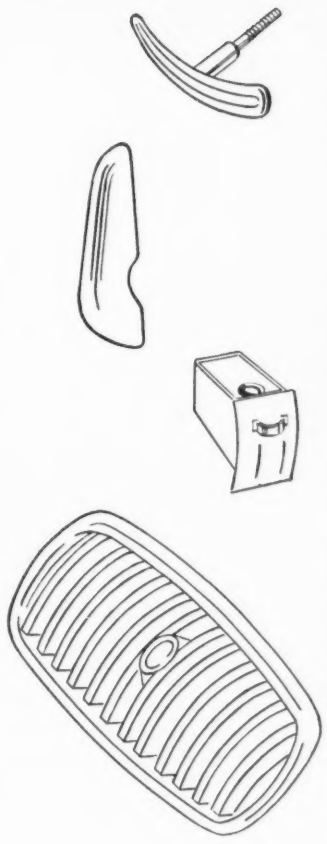
Another field report on "TRICLENE"® D



BUMPER GUARDS being loaded into roller conveyor degreaser at Grand Rapids Metalcraft by worker Ben Kolenda.

THOROUGHLY CLEANED with TRICLENE D, bright bumper guards are removed at end of degreaser by James Holliday.

"TRICLENE® D makes vapor degreasing easier than ever . . . now we can put through a larger volume of work,"

Says C. Nesselroad, Mgr., Grand Rapids Metalcraft, Division F. L. Jacobs Co., Grand Rapids, Mich.

"We operate six degreasers—two manual and four conveyorized," continues Mr. Nesselroad, "and since we turn out as many as 150,000 parts per day, we've found we just can't *afford* to have trouble."

That's why Grand Rapids Metalcraft uses TRICLENE D trichlorethylene. With this rugged solvent, they've had consistently thorough, trouble-free degreasing of the automotive stampings they manufacture—bumper guards, brackets, ash trays and grill parts. And with TRICLENE D, their volume of work handled has shown an *increase* . . . and maintenance costs have *decreased.* Furthermore, Mr. Nesselroad concludes, "We've never found a degreasing job that TRICLENE D trichlorethylene couldn't do!"

Locked-in stabilizers give TRICLENE D unsurpassed resistance to *all* major causes of solvent deterioration—heat, light, air, acids and aluminum chloride—yet this rugged solvent contains nothing to harm even delicately machined metal surfaces. TRICLENE D retains its original high purity longer . . . continues to give *brighter cleaning of any metal* job after job, distillation after distillation. And remember, it costs no more!

FOR MORE INFORMATION on TRICLENE D and how it can bring a new standard of efficiency to your vapor degreasing operation, write our nearest District Office. E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

DU PONT
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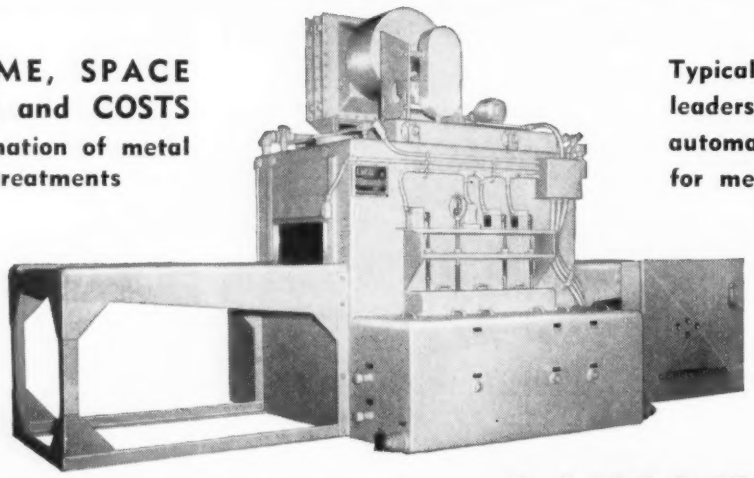
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

TRICLENE® D

TRICHLORETHYLENE

SAVES TIME, SPACE HANDLING and COSTS
on any combination of metal surface treatments



Typical of Ransohoff leadership in creating automatic equipment for metal finishing.

New "Walking Spray" Cabinet Type *RANSOMATIC*

offers a big opportunity for economy if you now use still tanks

Just roll a batch of work into the cabinet of a Ransomatic, press a button, and the work will be treated with any pre-determined sequence of solutions and rinses — thoroughly, accurately and efficiently. Can be built for any size work or any number or combination of solutions. Also built in drum type for work that can withstand rolling. Send for complete details.

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FOR THE PLATER

Metallizing Non-Conductors

By SAMUEL WEIN

64 pages
5½ x 7⅞ paper cover

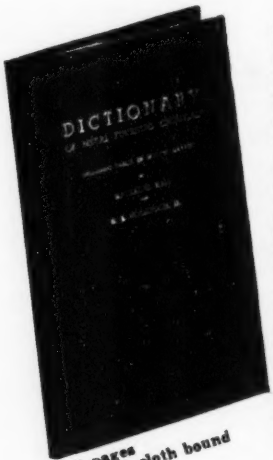
The present work deals with every known method for "metallizing" or the deposition of metals by electrolysis (plating) or non-conductors. It is divided into several sections, i.e., those processes which use chemical, mechanical and physical methods for treatment of surfaces for metallizing. In these groups the specific methods are chronologically reviewed and so the reader can very readily get a better idea of the progress made by the various workers in these arts. At the end is an alphabetical listing of contributors to the art, so that the serious workers can refer to the original sources of the information given in the text by Mr. Wein.

The text is prepared in a practical fashion so that the formulas given will be of material use and is the result of literature collected by the author for more than 25 years and which has been in use by a number of industrial concerns here in the United States and abroad.

PRICE $2.00

Dictionary of Metal Finishing Chemicals

By HALL and HOGABOOM



129 pages
5¾ x 8½ cloth bound

This volume fills the need in the metal finishing field for a handy source of information concerning the chemicals employed. The technical and common names are listed in alphabetical order together with information as to physical appearance, chemical formula, molecular weight, melting and boiling points, and solubility. Available grades, types and sizes of shipping containers are also given, all of which are of help in identifying the contents of unlabelled packages which are found in most plating rooms. A special section contains tables of degrees Baumé and specific gravity for solutions of a great many salts. Various solutions and dips employed in the finishing department may be easily controlled by the use of a hydrometer and these tables. The authors, editors of the **Plating & Finishing Guidebook** and associate editors of **Metal Finishing**, as a result of their familiarity with the requirements of the industry, have compiled a reference volume which belongs on the shelf of every metal finisher.

PRICE $3.00

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381 Broadway, Westwood, N. J.

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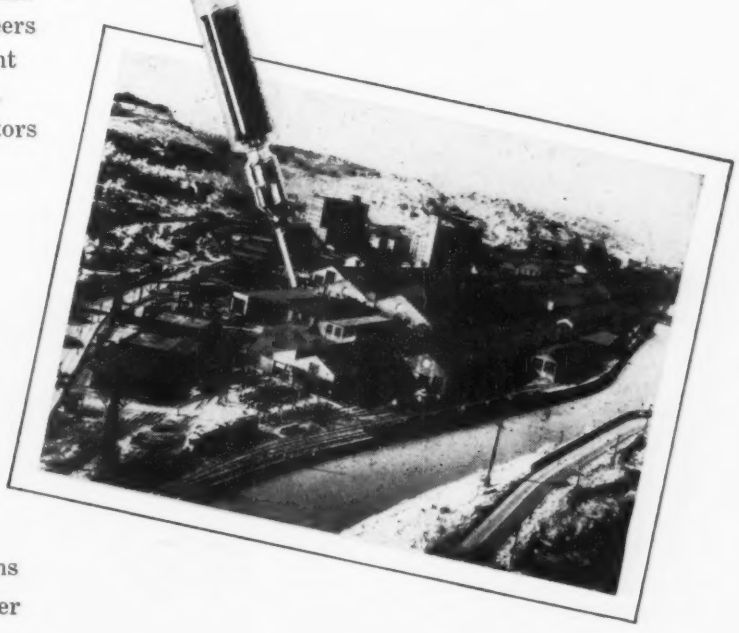
Experience with plating waste treatment has shown staff and consulting engineers that no one process or type of equipment is generally applicable to all problems. Thorough evaluation of the many factors involved is necessary in each case.

Whether the solution required is ion exchange or precipitation Graver has complete equipment to do the job.



Graver can offer you:

*Choice of either basic process and equipment

*Engineered flexibility to suit individual requirements

*Advanced equipment design proven in hundreds of installations

*Over 45 years' experience in the water and liquid treatment field

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T-136 — Plating Waste Solutions — Recovery or Disposal
T-130 — Ion Exchange A Practical Tool in the Plating Room
T-123 — Applications of Ion Exchange to Plating Plant Problems

GRAVER

Industrial Waste Treatment Dept. W-113
GRAVER WATER CONDITIONING CO.
A Division of Graver Tank & Mfg. Co., Inc.
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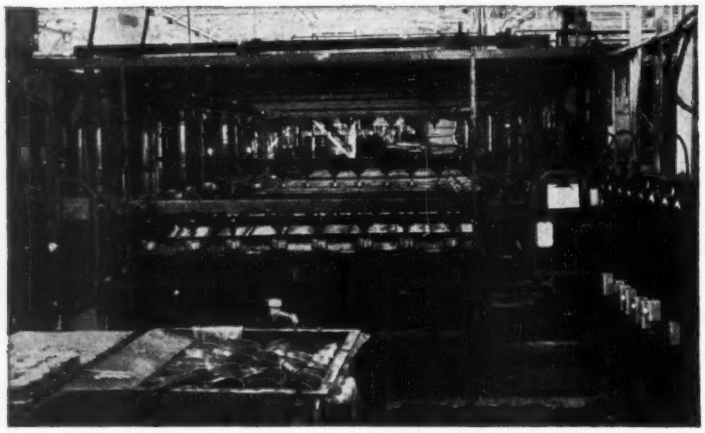
New High Standards in Plating • Processing • Cleaning



U.S. Fully Automatic Equipment for processing and heavy copper plating the bottoms of popular brand stainless steel cooking utensils. 10 such U.S. installations are in service in 3 plants of this manufacturer.

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US

Since 1896

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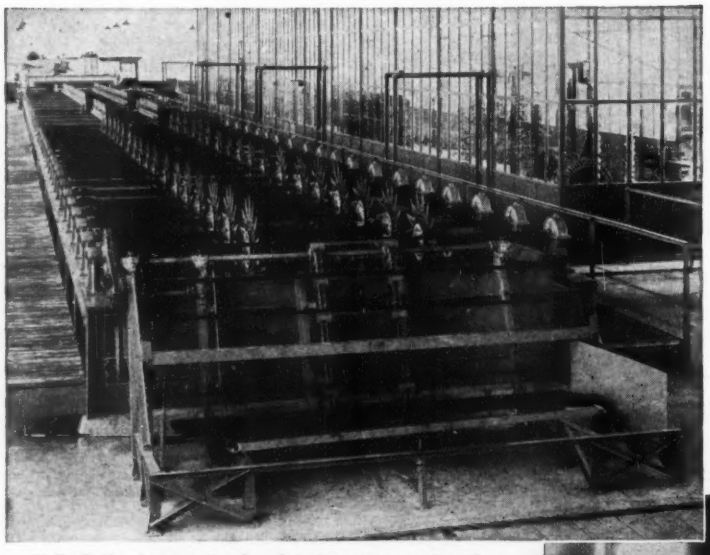

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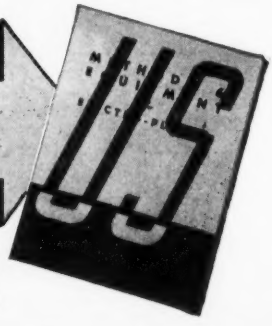

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SEPTEMBER, 1955 Volume 53 Number 9

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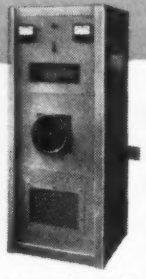

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ESTABLISHED 1903 VOLUME 53 • NUMBER 9 • SEPTEMBER, 1955

Penny Wise - - Pound Foolish

Visiting, as we regularly do, what could be termed a representative cross-section of industry, we never fail to note the large number of plants in which the plating department is still suffered as a necessary evil instead of being considered one of the most important production operations.

Although it is axiomatic that eye appeal is a determining sales factor and that wear and corrosion resistance are prime requisites of a quality product, a constant source of wonder to us is the outstanding neglect evident in these plants with respect to the efficient production of the finish. We see successful manufacturers who proudly point out the latest in tool and press-room equipment, which they replace long before obsolescence dictates this step, yet are not convinced that a filter is a necessary piece of equipment. We usually tell these executives that they are not operating a plating "department" but a plating "room." Those familiar with practices of the carriage days may smile at the connotation.

A pound of metal goes a long way in our field. It will coat over 43 square feet of steel with a deposit of copper half a mil thick. It will plate a hundred electric iron tops with a retail value of many hundreds of dollars. Yet, every time the metal market tightens, loud cries of anguish arise from individuals who have lacked the foresight to maintain an inventory consistent with their production requirements. Year after year the same thing happens to them but they never seem to learn. Once it's cadmium, then tin; now it's copper. These are the same users who found themselves without a base period of purchases when nickel went on allocation. Is there any logical reason why the anodes in a tank have to wear down to thin spines or one-inch pebbles before reordering?

And, speaking of nickel, this metal has been offering a tempting attraction to pilferers since the shortages materialized and there appears to be a ready market among platers who prefer not to inquire too carefully as to the source. Of about forty plants we checked on recently, not one was taking the precaution of imprinting a name or mark on their anodes with an inexpensive steel die. A simple precaution, admittedly, but one which would act as a warning to a possible purchaser. Even if filed away or ground down, it would indicate questionable origin and act as a deterrent to petty thievery.

As we said before, it's all a source of wonder. However, we don't mind plugging away since, even if only a few readers obtain an idea or two it'll be worth while.

Nathaniel Hall

Rinse Tank Control

By J. B. Mohler, *Consultant, New Castle, Penna.*

THE subject of rinsing has recently attracted considerable attention, as indicated by a number of articles[1,2,3] on the subject. There are several reasons for this. First, it has become obvious that the use of excess water is costly and that worthwhile savings are possible in the rinsing step. Secondly, the public in general is water conscious and the necessity both to save water and to treat polluted water have become current problems. They are problems that are being faced and something is being done about it.

Rinsing is commonly done with a single running rinse tank, but other means are often used, according to the requirements. Multiple rinses are employed both on manual plating lines and on automatic equipment. Fog rinses are used to reduce drag-out from the bath and to reduce contamination to the running rinse. Running rinses are supplemented with spray nozzles to incorporate two rinsing steps at a single rinsing station. Also, where the rinse is used only occasionally, sprays can replace the single running rinse, especially for parts which are of simple shape and have no areas which are shielded from the spray.

Multiple rinses have been commonly used for many years for the final rinsing steps. Where it is desired to use a hot rinse, this has been preceded by a cold rinse in order to maintain a low flow in the hot rinse and thus keep the heating requirements to a minimum.

In most cases the single running rinse will retain its popularity. The advantages of the single rinse are that it requires the least amount of floor space and, in manual plating, the least amount of labor. The obvious disadvantage of the single running rinse is that it requires much more water. Whether or not a multiple rinse will pay is a matter of balancing the cost for extra tanks, floor space and labor against water cost. In some cases the multiple rinse would pay, were it not for the expense of dismantling existing plating lines to fit in the additional rinsing stations.

In cases where water costs are high, substantial savings are possible by the use of controlled rinse tanks since, whether rinsing is single or multiple, less water will be required to maintain quality than with the uncontrolled rinse tank.

The Rinsing Problem

Rinsing is not done with clean water; even if demineralized water is used, it becomes contaminated as soon as the first rack is introduced into the rinse. The rinsing problem, therefore, is to determine the maximum permissible concentration of chemicals in the rinse. If the salt concentration in the rinse is high, drag-in of unwanted chemicals to the next tank will be high, with resulting contamination and with loss of plating quality. If the rinse is necessary at all, then some maximum concentration should not be exceeded. If the concentration in the rinse is kept too low, excessive amounts of water are used and in addition to water costs, greater demands are put on water lines and drains.

The rinsing problem is one of rinsing with water of controlled contamination. The contamination should be low enough to maintain quality and high enough to keep water usage as well as water costs down.

At the highest allowable concentration in the rinse the soluble chemicals are most efficiently removed, since the most ounces are obviously carried down the drain in each gallon of water. In fact, the rate of removal of chemicals is directly proportional to the concentration in the rinse tank. At one-half the concentration, it will take twice as much water to remove the same weight of chemicals. The drag-in is a fixed quantity that must be removed. The rinse tank has no influence over the tank preceding it in the line. Therefore, when water is fed to the rinse tank continuously but work is not being processed through it at regular periods, the rinsing efficiency steadily and rapidly decreases. Whenever the rinse runs without work being processed, water is being wasted. Water is wasted when the line is started in the morning, before plating has begun. Water may be wasted during lunch hour, during a coffee-break and during every break in the production schedule. Of course, the rinse tanks can be shut off manually, but this is time-consuming and also means that someone must remember to turn them on again

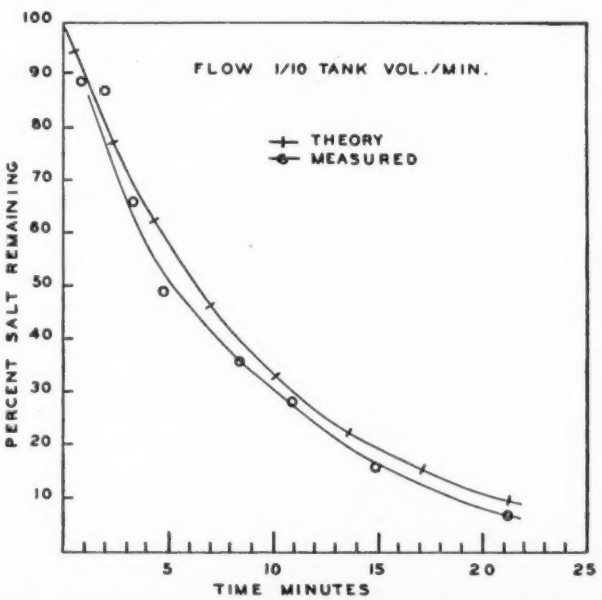

Figure 1. Decrease in concentration with time in running rinse tank.

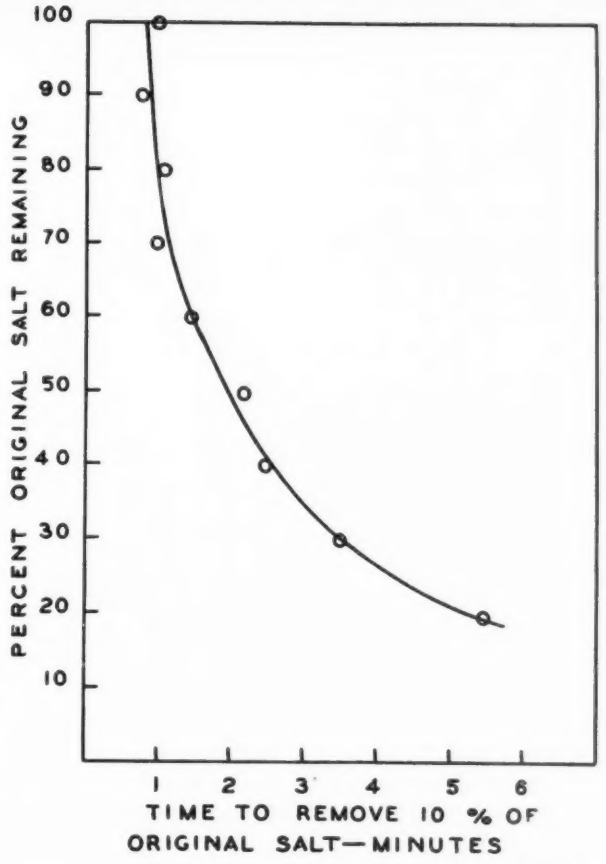

Figure 2. Time necessary to remove given weight of chemicals at various concentrations in running rinse tank.

to avoid troubles with quality. The result has generally been to let it run rather than to turn it on and off frequently.

Automatic Rinse Control

An effective solution to the rinsing problem is the use of automatic rinse control. Automatic controllers based on solution conductivity may be installed for such purposes. A conductivity instrument is accurate at the low concentrations encountered in rinse tanks, with the result that the response of the instrument is very good.

The conductivity controller is a line voltage energized Wheatstone bridge using an electronic "eye" as its null indicator. It contains a measurement circuit, and a vacuum tube relay circuit which is operated directly by bridge unbalance. One leg of the measurement circuit is an external conductivity cell which is remotely immersed in the rinse tank. Variations of the chemical concentration affect the cell, which in turn affects the bridge measurement circuit. The vacuum tube relay circuit operates a solenoid valve when conductivity of the rinse water exceeds or drops below the pointer setting on the controller panel.

This type of instrument is relatively inexpensive and easily installed; it will limit the maximum salt concentration in the rinse and also maintain a high minimum by automatically supplying and shutting off water as required.

Figure No. 1 shows a curve for rate of washing away of salt, as determined with a laboratory type conductivity meter. The flow was one liter per minute in a 10 liter tank or 1/10 tank volume per minute. The data show that the washing away of the salt is proportional to the concentrations[4] and the rate of removal decreases greatly with time. Figure No. 2 shows how the time necessary to remove 10% of the original salt increases as the concentration drops. At 100% concentration the time is one minute, at 50% concentration two minutes, and at 25% concentration four minutes. This demonstrates that the rinsing efficiency drops significantly in a few minutes. For a higher flow, the rate of drop would be more rapid. The conductivity controller responds only to the concentration, and is independent of the rate of flow. At a high flow rate it will turn water on and off more frequently. In some applications a high flow rate might be desirable in order to wash away contaminating chemicals at a high rate while the work is still in the tank.

Figure No. 3 shows a typical curve measured with a laboratory type conductivity meter for an uncontrolled rinse tank. Figure No. 4 shows a similar case with a conductivity controller holding the concentration between 0.04 and 0.05 ounces per gallon. The dotted lines represent the time when the water is not flowing.

The conductivity controller permits rinsing to become a known factor. If there is an indication of gradual changes in the plating line, the chemical concentration in the rinse can be increased or decreased merely by changing the setting of the controller. The rinse concentration can be entered on the plating log and

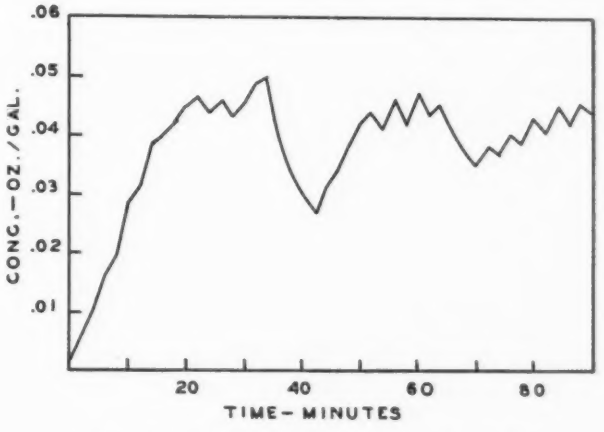

Figure 3. Variation in concentration in rinse tank.

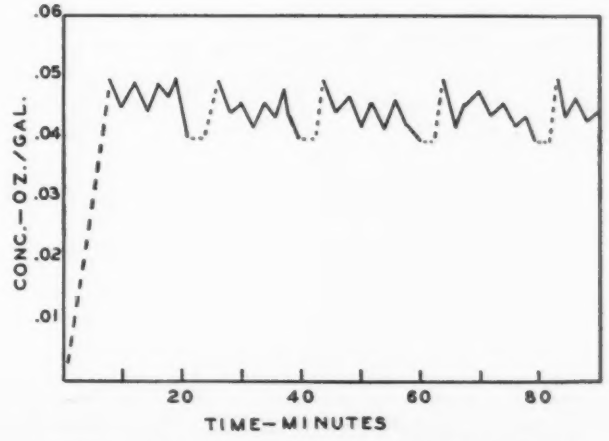

Figure 4. Variation of concentration in controlled rinse tank.

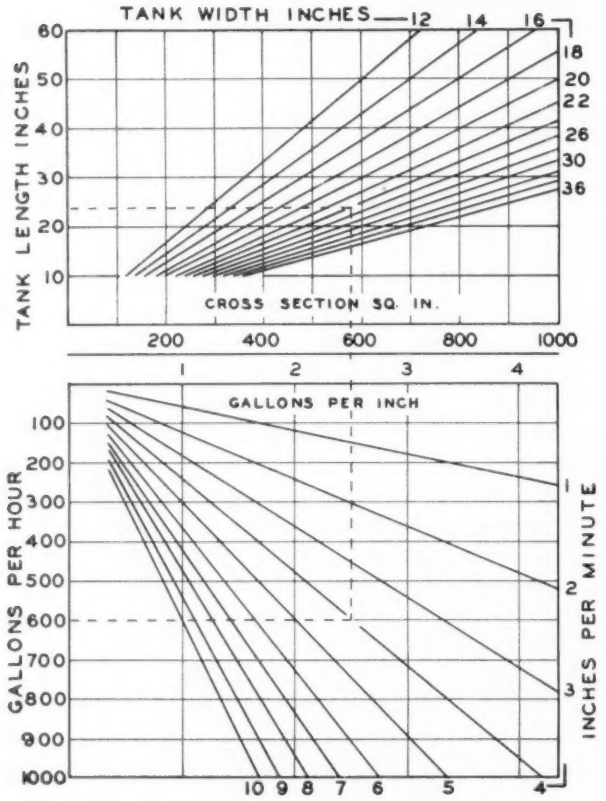

Figure 5. Estimation of flow in rinse tank determined by rate of rinse of water.

the most economic control level can be established by observation of quality over a period of time. The concentration in the rinse remains fixed regardless of changes in water pressure and usage of water for other purposes.

The controlled rinse can also be used to determine dragout. If a water meter is installed in the water line to the rinse then the total flow at a known concentration can be determined at any time. This will tell the total pounds of chemicals removed from the preceding tank for any given period of time. Such knowledge can be used for drag-out calculations to estimate what is happening in the rest of the line. It will also indicate if longer draining times or plating rack redesign are desirable to reduce chemical costs.

With automatic control on rinse tanks it is possible to establish specific recommendations for rinse tank concentrations. At the present time it is felt that practical concentrations will be in the range of 0.1 to 0.01 ounces per gallon and that the extremes may be as great as 1.0 to 0.001 ounces per gallon, depending on the purpose of the rinse tank. In any case, it will certainly be found that a wide range in rinse concentration is practical and that, in many cases, great excesses of water are being used merely because the rinse is an unknown factor and an excess of water is considered to be erring on the safe side.

A rinse tank may be inadequate or overworked. If a controller is installed on such a tank and the water supply is inadequate, the rinse will run continuously and the controller will function as an indicator to show the concentration obtained. Corrective measures will consist of getting more water to the tank, reducing drag-out or installing a second rinse, or a counterflow rinse tank. It must be remembered that a controller will work just as effectively on a counterflow rinse as on a single rinse.

Estimation of Flow Rate

The flow for a running rinse tank can be easily estimated by the following procedure:

While the rinse is running, dip out several buckets of water and time the rate of rise. Or siphon the rinse, set the valve and measure the rise in inches for one or two minutes. From the rise in inches per minute the flow can readily be determined from Figure No. 5. An example is given by the dotted line. For a 24 x 24 inch tank and a rise of 4 inches per minute the flow is 600 gallons per hour. The graph also gives the cross section in square inches and the volume of tanks in gallons per inch, which is useful general information.

Determining Concentrations

The concentration in the final rinse will depend on the concentration that must be maintained to avoid spotting on the work and, in critical applications, will be less than 0.01 oz./gal.

The concentration of chemicals in a rinse at any given time is easily determined by the conductivity method. All that is required is to measure the conductivity of the rinse and to measure the amount of solution required to produce the same conductivity reading by addition of the proper portion of the bath to a fresh sample of water. The data that are needed for a simple and accurate analysis are as follows:

1. The conductivity of the rinse.
2. The amount of bath added to a known volume of fresh water to obtain the conductivity of 1.
3. The analysis of the bath.

Conductivity controllers have been used to control rinse tanks for a number of years, but not in the electroplating field. Consequently it is expected that the electroplater will discover advantages beyond those now generally known.

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Surface Treatment and Finishing of Light Metals

Part VII. — Industrial Anodizing of Aluminum and Its Alloys

By S. Wernick, Ph.D., M.Sc., F.R.I.C., F.I.M. and R. Pinner, B.Sc.

BEFORE dealing with the major anodizing processes in present-day use, it is instructive to consider some of the general principles common to them all.

The Basis Metal

In general, aluminum anodizes better than its alloys, and an appreciable difference is to be detected between the color of coatings produced on the various grades of aluminum. The difference between commercial-quality material (99%) and super-purity aluminum (99.99%) is particularly noticeable. The nature of the impurities is also of importance, i.e. whether impurities are present as intermetallic compounds, situated in the grains of the metal, or at the grain boundaries, or are non-metallic inclusions. In heterogeneous alloys it is, for example, important to know whether the impurities remain unchanged in the coating, or will be oxidized or dissolved during anodic treatment.

Keller and Edwards,[1] who conducted a series of experiments on the effect of impurities, found that silicon was not oxidized or dissolved during treatment, while intermetallic compounds such as $CuAl_2$ and the -Al-Mg phase, which occurs in certain aluminum-magnesium alloys, were oxidized or dissolved much more rapidly than aluminum, with the result that the coatings produced were thin, rough and porous. Intermediate between the two extremes are constituents such as $FeAl_3$, the Al-Fe-Si phase and $MnAl_7$, of which part is dissolved and part remains in the coating, and affect the color, transparency and continuity of the film to varying degrees.

Fischer, Budiloff and Koch[2] anodized intermetallic compounds separately. Among those which took oxide films were $MnAl_6$, $FeAl_3$, $CuAl_2$ and silicon. Others, e.g. Al_3Zn_2 and lead were partly dissolved and partly anodized, while $Mg_2Si_2Al_3Mg_2$ and $Al_2Mg_3Zn_3$ were dissolved.

The distribution of these compounds, e.g. silicon in aluminum-silicon alloys, has also been found to affect the oxidation voltage in the heterogeneous condition. For example, alloys of the Al-Mg-Si and Al-Mg type give higher oxidation voltages than when the alloys are in supersaturated solution. Differences between heterogeneous and heat-treated condition were found also in the case of Al-Cu-Mg, Al-Si, Al-Cu and Al-Mg-Zn alloys; in the last two, the oxidation voltages were higher in the homogeneous state.

Heterogeneity of the basis metal thus leads to heterogeneous coatings which possess inferior corrosion resistance and are darker and more opaque, simultaneously adversely affecting the dyeing properties.

Defects in coatings caused by impurities may, to some extent, be counteracted by increasing the film thickness, when there is a tendency to eliminate weak spots by growth of oxide around unoxidized or partly oxidized constituents. Apart from their importance in anodizing, impurities have a considerable influence also in electropolishing, in which super purity metal must be employed to maintain the maximum reflectivity.

The maximum film thickness depends upon the alloy composition; Fig. 1 shows the behavior of a number of alloys in sulphuric acid anodizing. The thickest coatings are obtained with pure aluminum, the thinnest with the heat-treated heavy-metal-containing alloys, while the length of time and current density required to reach the maximum thickness is in the reverse order. In some cases, notably with some Al-Mg alloys and some heavy-metal-containing alloys, the film thickness may decrease again after the critical value is reached.

For practical purposes the current required per unit film thickness depends on the effect of the alloying constituents on the conductivity of the coating. Thus alloys containing magnesium and zinc increase the conductivity to the film and, hence, give thicker coatings per unit of electricity than copper-containing alloys where segregated $CuAl_2$ for instance, increases the ohmic resistance. Experiments carried out by Fischer, Budiloff and Koch[2] have shown the relationship between the voltage and anodizing time and other properties with different alloys. The most important factor was found to be the homogeneity of the alloy. Increase in hetero-

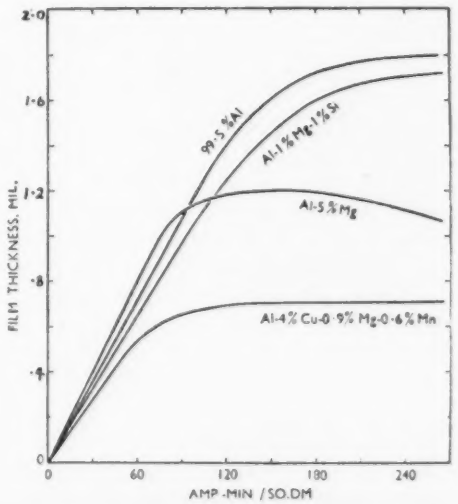

Figure 1. Anodizing behavior of some commercial aluminum alloys in sulphuric acid.

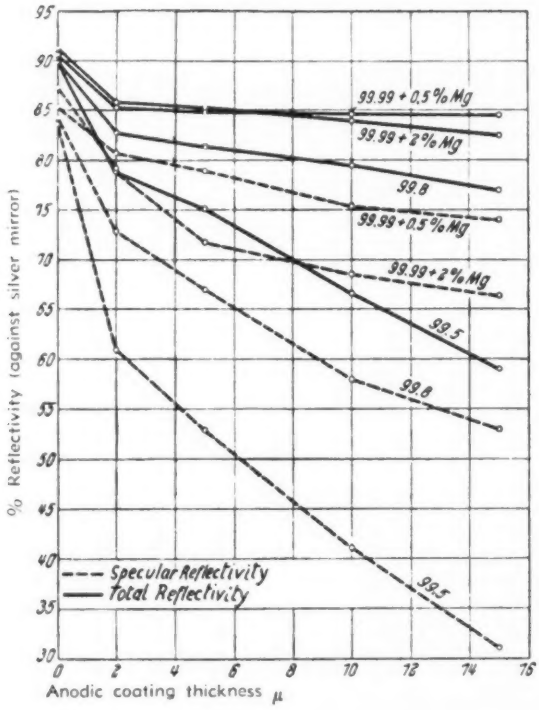

Figure 2. Effect of sulphuric acid anodizing on the reflectivity of aluminum chemically polished by the Alupol process.

geneous constituents had the greatest influence on the reflectivity, and the color of the coating was not affected until substantial amounts of segregated constituents were present. Two groups of alloys were distinguished, viz. those which show the highest oxidation voltage (1) in the homogeneous and (2) in the heterogeneous condition. Group 1 includes the Al-Cu and Al-Cu-Mg type alloys, Group 2 the Al-Mg, Al-Mg-Si, Al-Zn-Mg alloys, as well as commercial aluminum. The difference in behavior is attributed by the authors to the effect of the constituent on the resistance of the coating, e.g. in the heterogeneous alloys selective attack on the dispersed constituents causes the formation of sparingly soluble basic salts in the pores, while in Group 2 the increase of voltage in the case of silicon alloys is explained by the relatively high oxidation potential of the metal itself.

In the homogeneous condition, the alloys still behave differently from super-purity aluminum. Thus, compared with the latter, the presence of copper in solid solution and manganese and silicon increase the voltage probably by producing a denser coating, while the opposite effect is observed in the Group 1 alloys.

The effect of magnesium content on the anodic coating thickness is well demonstrated in Fig. 2. Here it is seen that increasing magnesium content substantially increases the rate of oxidation at least initially though, as already stated, the coating may decrease in thickness after a certain time, as stated by Lacombe.[3] The formation of a film of uniform thickness requires a perfectly homogeneous alloy. If variations in the composition of the solid solution exist, they are revealed after oxidation in the form of undulations. This is shown, for example, in Fig. 3 on an aluminum-3% magnesium alloy after anodizing at 15 amp./ft.^{2} for 30 minutes and is particularly likely to occur when alloys are prepared from high purity metal, as shown by Herenguel and Segond.[4]

A similar effect may also be noted in the case of the high purity metal itself. Such effects have been shown by Herenguel and are reproduced in Figs. 4 and 5.

Fig. 4 shows retardation on high purity aluminum which has been rolled and anodized, and shows up the grain boundaries. In part this effect may be caused by faulty rolling (see Fig. 5), and may be corrected by cold rolling followed by light etching. This sensitivity of high purity metal may, of course, be put down to the greater effect of the differences in potential between the grain and grain boundaires compared with the commercial purity metal in which this difference is to some extent marked by local cells due to impurities.

In the case of commercial aluminum as in multiphase alloys, a large number of intermetallic compounds may be present in the surface and their chemical composition and dispersion will be effected by heat-treatment. Recent work in France[3] has shown that silicon and silicon-rich phases as well as Al_6Mg_6 are oxidized much more slowly than aluminum and thus remain dispersed in the anodic coating with loss of transparency while Al_3Mg_2 and Al_2Cu oxidizes at a faster rate and may leave gaps in the oxide film. Fig. 6 shows the effect of the former on an Al-9% Mg alloy which has been annealed at 200°C. and in which the film has been darkened. In some cases insufficient homogenizing of such alloys may result in a band structure of Al_3Mg_2 which follows the direction of roll-

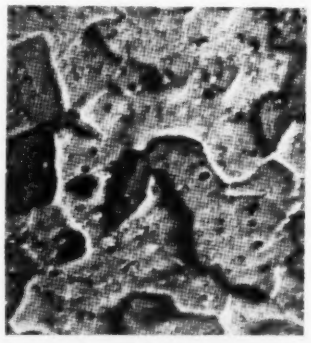

Figure 3. Differences in level from grain to grain, caused by differences in oxidation rate, in an aluminum—3%-magnesium alloy made from pure metal (1.5 amps./dm.^{2}, 30 mins.). The surface carries an alumina film. Oblique illumination.

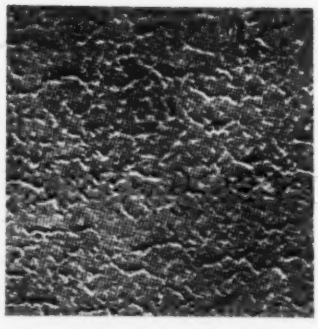

Figure 4. Surface of slab of aluminum — 3% magnesium alloy after hot rolling to 6 mm. with faulty rolls. × 1·7

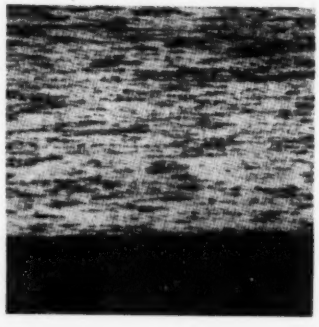

Figure 5. Same surface as Fig. 4 after cold rolling to 1 mm. and light pickling. × 1·7

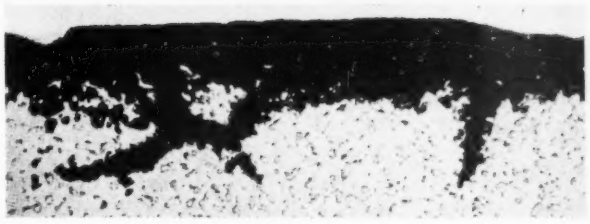

Figure 6. Section of anodic oxide film formed on aluminum—9%-magnesium alloy annealed for 250 hours at 200° Co.

ing. These bands show a dark color after anodizing and is shown in Fig. 7.

Experiments carried out by Shreider[5] showed that surface roughness on the basis metal gave decreased corrosion resistance on anodizing, and a more positive electrode potential.

In general, wrought alloys are superior to cast alloys for anodizing, due to their greater homogeneity, the smaller particle size of impurities, lesser porosity, as well as the fact that the chemical composition of cast alloys, especially their high silicon content, makes them less suitable for anodizing purposes.

Gravity die-castings are more suitable for anodizing than sand castings, the latter requiring most pre-treatment. Schenk[6] lists Al-Mg-Si (Si-2.5% max.), Al-Mg_2 and Al-Zn-Mg type casting alloys as being the most suitable for decorative anodizing. According to Smith,[7] sand-castings do not dye satisfactorily due to blow-holes and porosity, while pressure die-castings produce a dark and patchy coating. Among gravity die-castings, the binary Al-Mg and Al-Cu alloys containing more than 95% aluminum are satisfactory, while ternary and quaternary alloys are of restricted value for decorative anodizing, due to uneven segregation effects, which can, however, be to some extent overcome by solution heat-treatment. Keskulla and Edwards[8] have produced light, attractive and corrosion-resistant coatings on die-casting alloys containing 8% magnesium, and alloys containing 2% copper and 2% nickel. Coatings on aluminum-silicon alloys darken with increasing silicon content. A fairly light coating of relatively poor abrasion resistance has also been obtained on an alloy containing 7% copper and 3% silicon.

Among the wrought alloys, the aluminum-magnesium alloys with or without manganese or chromium additions and the heat-treatable Al-Mn-Si and Al-Zn-Mg alloys produce the best decorative coatings, though the great majority of wrought alloys can be anodized by one process or another. Alloys containing appreciable amounts of copper and other heavy metals, e.g. duralumin-type alloys, usually produce coatings of inferior color.

Schenk[6] gives the following figures for maximum alloying constituents for decorative anodic coatings:

Iron	0.5%
Silicon	2 to 3%
Copper	1 to 2% (up to 5% in d.c. sulphuric-acid processes)
Manganese	0.5 to 0.8%
Magnesium	7%
Zinc	6 to 8%
Chromium	0.3%
Titanium	0.3%

In some cases, corrosion of the basis metal even before anodizing may have adverse effects on the anodizing properties. Thus, hydrogen may be dissolved in castings, and may interfere with the coating, while defects due to oxide rolled into the metal during fabrication, or due to segregation of alloy constituents, will often be emphasized in the coating which may show a misty or net-like appearance or merely lack lustre. Similarly, the position of gates in castings often becomes visible on anodizing, due to structural differences in the areas involved. Many anodizing defects are due to uneven batches of metal, and the greatest care should be exercised in supervision and testing of materials; metal of "anodizing quality" being used wherever available.

Pre-Treatment

Anodizing requires a high degree of cleanness of the metal to be treated. If oil or grease is allowed to remain on the surface, patchy coatings are obtained, nor will the solution itself operate satisfactorily if contaminated. In this respect, anodizing is different from chemical treatments which employ an alkaline solution, which itself has a cleaning action.

The surface of parts to be anodized is cleaned by vapor degreasing or solvent emulsion cleaning and often given an additional alkaline cleaning treatment. The cleaning operations have been described in detail in an earlier article.

Similarly, contamination must also be avoided after anodizing. Coatings contaminated by oil or grease will not dye or seal satisfactorily. As well as oil, grease and solid dirt, the presence of oxide skins on the metal may interfere with film formation. Such oxide may be formed during casting or heat-treatment and can be removed by acid solution, e.g. nitric acid-hydrofluoric acid; if not effectively removed, oxide skins will cause discontinuities in the coating. Etching must, however, not be prolonged longer than necessary, as some of the heavy-metal containing alloys, in particular, may become more susceptible to stress-corrosion. Nor should etching leave a rough surface as the increase in surface

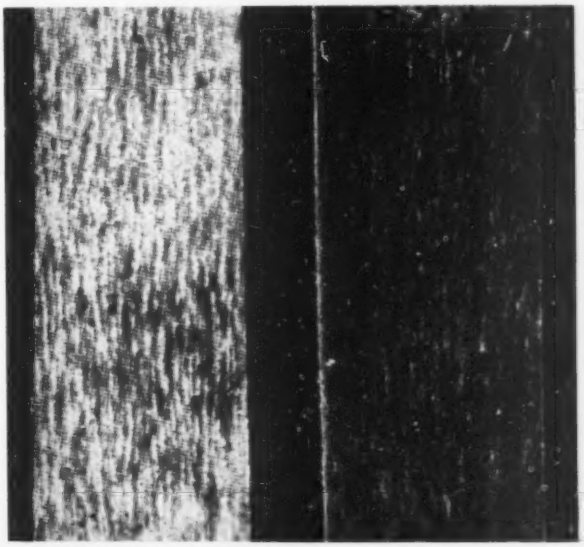

Figure 7. Appearance of "elongated mottle" on aluminum—9%-magnesium alloy, annealed (a) 2 hours (b) 5 hours at 240° C. × 2.

area due to roughness leads to thinner coatings for a given set of operating conditions, as well as adversely affecting the appearance and corrosion resistance.

The same effect is observed when a rough-ground surface is treated, and such are therefore usually polished to a high degree before anodizing.

Racking for Anodizing

The objective in racking is to make handling as easy as possible without running the risk of deforming the work in racking or unracking or by movement between loose points of contact, etc. Points of contact should be chosen with care preferably, of course, in positions which are hidden to the eye, as no film is formed at points of contact. Three or more points of contact may be necessary in order to avoid movement of the part within the rack. Each contact point should not be allowed to carry more than 10 to 20 amperes.

The racks or wire employed should preferably be of aluminum or, more rarely, aluminum alloy, and must be of an adequate section to hold the current. This has been estimated[8] at 1 sq. in. of metal cross-section per 1,000 amperes.

After anodizing, points of contact on racks are stripped, usually by immersion in cold, dilute, sodium hydroxide solution, or mechanically, and are subsequently rinsed in hot water. Alternatively, racks may be stopped off with an organic material, and electrical contact made by cutting through the stop-off.

If possible, racks should be designed to hold the work at equal distances from each other and the cathode. Contacts must be tight to prevent arcing and film formation between rack and contact which would increase the resistance and may stop the current altogether. Insulating material is sometimes hung between the electrodes to prevent short circuiting by anode movement due to bath agitation. Racks have recently been described by Engle.[10]

Throwing Power and Auxiliary Electrodes

Compared with most electroplating solutions, the throwing power of anodizing solutions is excellent due to the high electrical resistance of the Al_2O_3 film in relation to that of the electrolyte and, provided the gases are allowed to escape from the work, virtually little difference in film thickness over the surface will occur. As another example, aluminum sheet suspended close to and parallel to a single cathode will be coated on both sides,[11] film formation beginning on the further side, when the resistance of the electrolyte between the cathode and the near-side added to the resistance of the coating is equal to the resistance of the solution between the cathode and further side.

The use of auxiliary cathodes is necessary, however, where hollow bodies with small openings are to be treated, the resistance of the electrolyte being proportional to the cross-sectional area of the opening. Where the inside of tubes is to be treated, the problem becomes difficult and, for long, narrow and bent tubes, anodizing is often replaced by chemical treatment.

The throwing power of anodizing solutions can be determined without difficulty by using Pan's method[13] as adapted by Herwig and Leigh,[14] in which an aluminum box, constructed of two pieces is used. The sides and ends are faced off and one side of each piece is lapped. The lapped sides are bolted together and placed against a backing plate into which different sized holes are drilled. Visual inspection shows the depth to which the solution will throw. If colorless coatings are investigated, the whole structure is immersed in a black dye, and depth of color will be proportionate to the film thickness. After opening, the coating may be further subjected to salt-spray to test corrosion resistance.

Anodizing Equipment

TANKS:

Mild-steel or alloy-steel tanks are commonly used in chromic acid processes. Other solutions are usually worked in lead-lined steel or stainless steel tanks. Tanks must be easily drainable and should slope towards the outlet to facilitate draining and cleaning. When the tank wall is used as cathode, sufficient distance must be maintained between the work and tank wall and floor. Filtration should be provided.

TEMPERATURE CONTROL:

This is of the greatest importance in anodizing, the temperature of the solution often being kept within a range of 4°C. (± 2°C.). Normally, it is necessary to cool the solution, even when the operating temperature is higher than room temperature as, due to the large electrical resistance of the anodic film, high temperatures are developed locally. Cold water circulating in cooling coils is usually sufficient, though occasionally a refrigerating system is required, e.g. in hard anodizing. In normal anodizing, if good agitation is provided and the tank is small, a water jacket with running cold water may suffice. Where cooling coils are used, they should be of lead and be fitted along the tank walls and not rested directly on the bottom.

Baths may also be heated in a similar manner, i.e. through hot water or steam carried in coils through the bath, or by a waterjacket. Wherever possible, it is advisable to use a thermostatic temperature control.

AGITATION AND EXHAUST SYSTEM:

The electrolyte is normally agitated by air, as in electroplating, and the air for this must be clean (free from oil, etc.). Alternatively, mechanical stirring in the form of anode rod movement may be used.

Both chromic acid and sulphuric acid solutions should be fitted with exhausts, similar to the type used in chromium plating. The exhaust needed is usually, however, rather less than in the more concentrated chromium plating solution, and has been given as 45 to 55 cu. ft. per sec. for a 100 to 200 gallon bath, using 500 amp.[6]

CATHODES:

The tank walls are sometimes employed as cathode, though this is not to be recommended as it increases the corrosion of the walls. Also, some important electrolytic reactions, which affect the life of the electrolyte, often depend on the maintenance of a proper anode-cathode area ratio. The use of separate cathodes is necessary with large tanks, and also makes cleaning of the tank substantially easier. In the case of the sulphuric acid bath, particularly, there is a danger that

the tank wall may be perforated if used as the cathode.

Cathode materials used are stainless steel in the case of chromic acid solution, lead with sulphuric acid solution, while carbon, lead, iron and steel cathodes are in use with oxalic acid processes.

In the case of a.c. processes, no cathodes are, of course, required; both electrodes consists of the work to be anodized, and are cathode and anode alternately.

In general, the following factors are to be taken into account in the routine control of an anodizing solution:

(1) Evaporation losses.
(2) Spray losses.
(3) Drag out
(4) Losses due to neutralization of the solution by dissolved aluminum and impurities.
(5) Losses caused by electrolytic reaction, both cathodic and anodic, as well as chemical secondary reactions caused, e.g. by dirt, carried over cleaning solutions, etc.

Bath control is thus similar to electroplating, and includes restoring evaporation losses by working to a given bath level, pH measurement or volumetric analysis of the acid content, determination of aluminum content, and impurities such as chloride, organic impurities, etc. In addition to control of the solution, physical and mechanical tests may be carried out on the anodized work, which include control of film thickness, porosity, corrosion, and wear resistance, flexibility, reflectivity, etc. Such tests, as well as methods of analysis of anodizing solutions, are described in a later installment and are often supplementary to each other, as specific properties required may depend more or less critically on the balance of bath constituents and the operating conditions.

Barrel anodizing has been applied on a limited scale to zipper fasteners and similar components, the barrel being rotated at sufficient speed to hold the work against the peripheral anode by centrifugal force.

Mechanization in Anodizing

Continuous anodizing using automatic equipment has only recently been put into use. Two different types of processes are to be distinguished.

(a) Continuous anodizing of wire and strip.
(b) automatic anodizing of finished products.

In both processes, the sulphuric acid process has generally been used, though there is, of course, no reason why other processes should not be employed. The Bengough-Stuart process is not suitable however due to the complex voltage cycle required.

WIRE:

Early attempts to anodize wire continuously were carried out in barrier type electrolytes and later with oxalic acid for the electrical insulation of aluminum wire, but the results were usually unsatisfactory in competition with insulated copper wire. The main difficulties are due to the high speed at which the wire is normally required to pass through the solution, requiring very high current densities to obtain coatings of adequate thickness. This is an example quoted by Pullen,[15] 18 gauge aluminum wire passing through a 20 ft. tank at 2000 ft./hour would require 100 amperes to give a 0.2 mil anodic coating in the 36 sec. treatment time. Such high currents are too high to be carried by the wire using normal contacts but have been overcome by the use of liquid contacts in which the current is fed into the wire via the electrolyte in one bath (sometimes a specially constructed chamber) from where the wire passes into the main tank.

A number of patents have been issued dealing with the construction of such units, in particular, the electrical contacts, and cooling of the solutions. Sulphuric acid is generally employed and an a.c. current may be added in some cases.[16,17] In one of these,[17] wire or narrow strip is passed through an electrode chamber made of ebonite which is placed at the end of the treatment tank with its bottom cover immersed in the solution, the wire or strip being passed through via a small nozzle arrangement. The solution level in the chamber is maintained by a pump, the overflow passing into the main tank. A third tank is included in the plant in which the solution is cooled. When d.c. is used, the wire is made cathodic while in the entry chamber and anodic as soon as it enters the main tank. With a.c., two electrode chambers are required, each being connected to one end of the secondary winding of the transformer and the electrodes consist of one or more pairs of wire equally distributed between the two chambers. A.c. is often preferred to d.c. for wire as the coatings obtained are more flexible. The dimensions of such a plant have been given by Pullen[15] as 10 ft. x 15 in. x 18 in. deep for the main tank which is of rubber lined steel, preceded by one or two small degreasing tanks and followed by rinse tanks. The take-off reel at the end of the sequence is provided with a variable speed drive to compensate for the continuous decrease in coil diameter as the wire or strip goes through. Where required, a dye bath can be included after the anodizing unit. At the currents used, which may correspond to up to 20 KW; cooling may be difficult to carry out satisfactorily in the tank itself, a pump is normally installed which takes the solution into an overhead cooling tank fitted with cold water coils or, where necessary, a refrigerator. A plant such as described would have a capacity of 8-12,000 ft. per hour, and requires about 300 amp. at 40 volts a.c.

Practical experience has found that a smaller plant is generally required where wires of diameters below 25-26 gauge are to be treated.

In the plant described by Pullen, it has not been found possible to include after-treatments such as sealing, oiling or lacquering in the main unit. Sealing, e.g. after dyeing, is carried out in this instance by immersing the finished coil in hot water for 3-4 hours followed by drying at 180°F. for a similar period. Organic sealing media are best applied during reeling onto the bobbins. Some figures with a plant of this type are given in Table 1.

The main advantages of such wires are their high temperature resistance, compared to organic insulating coatings. On radio type transformers wound with anodized wire, no failures were obtained using a load of twice the normal rating for 14 months at 250°C. average temperature. On the other hand, such wire is difficult to join. 'Electrical' purity wire may be ob-

TABLE I

Data for Continuous Wire Anodizing Plant

	Wire gauge s.w.g.	Speed ft./hour	Total current (amp.)	Coating Thickness (mil)	No. of wires in unit	Total Output per hour ft.	lb.
Large plant	18	2000	105	0.26	2	4000	8.5
	21	2000	75	0.25	2	4000	4.0
	21	3000	80	0.2	2	6000	6.0
	Flat tape 10.072 × 0.01 in.	2400	85	0.2	2	4000	4.0
	24	2000	40	0.2	2	4000	1.75
	26	2000	34	0.2	2	4000	1.2
Small plant	30	2250	51	0.16	6	12500	1.9
	30	2670	56	0.14	6	16000	2.3
	34	2250	35	0.15	6	13500	1.05
	36	3000	17	0.12	2	6000	0.3

tained for such purposes and Al-Mg alloys (0.5-1.0% Mg) are perhaps most suitable.

Another application is the production of woven wirecloth. This may be woven from wire anodized in one or several colors. A limitation is that the dyeing time allowed is very short (e.g. 3 sec.) and only pale colors can normally be obtained.

STRIP:

The potential advantages of continuously anodizing strip are that the process can be carried out cheaply in large quantities and components formed by subsequent operations. In practice, there are two limitations, however (a) the comparative brittleness of anodic coatings which craze or crack on bending; (b) the comparatively low speeds which can be used with anything but very large installations.

Sulphuric Acid Processes

The first sulphuric acid process was patented in England in 1927, though it was extensively used and developed in the U. S. A. Since then the use of sulphuric acid for anodizing has spread over the world, and many variations of the process have been patented.

Early solutions contained approximately 25% sulphuric acid; in later years the acid concentration has been reduced to 10 to 20% according to the film properties required, while several addition agents are in use. As in the case of chromic acid, all the industrial processes employ direct current. In the standard processes, current densities are normally of the order of 12 to 15 amp./ft.^{2} at 15 to 20 volts, and the bath is worked at 20°C. for 20 to 40 minutes. To obtain maximum corrosion resistance, the coatings are sealed, either in hot water or dichromate solutions, etc. or, in the case of dyed coatings, with nickel or cobalt salts.

The sulphuric acid coating is colorless, clear and transparent on aluminum, and homogeneous aluminum-magnesium and many other alloys.

With an alloy containing manganese or silicon and on heterogeneous alloys there is a tendency towards grey or brownish-grey coatings.

According to Pullen, strip between 6 in. to 2 ft. wide and with thickness of the order of 0.015″ is anodized in equipment similar in construction to that described for wire, though the tanks and other equipment will have to be much larger and more robust. The slow speeds used, approx. 500 ft. per hour are both a limitation and an advantage, the latter because sealing, oiling or lacquering operations can be incorporated into the line. In a Norwegian plant of this type, several hundred tons of this strip are anodized each year, mainly for aluminum food containers and, with the reservations given above, it has been found that a thin coating approx. 0.06 mil thick can be produced in 10% w/v sulphuric acid using 14 amp./ft.^{2}, 15-20 volts d.c., at 21-27°C., and is sufficiently flexible to withstand forming.

As in the case of wire, liquid contacts are in use but, in some cases, ordinary contact rollers have been found suitable due to the lower operating speeds and hence, the lower currents required. As is the case with strip electroplating units, tier construction has been used with effect, in order to conserve floor space. In such a plant the cleaning and rinse tank may be on ground level, from where the strip passes vertically through a spray rinse into the anodizing tank and rinse, which are on the second tier. A lacquering oven may be included on the third tier. Pullen estimates that a floor space of 120 ft. x 6 ft. is sufficient for such a unit. A dye bath may be included but, as in the case of wire, only pale colors will be obtained successfully and uniformity may be difficult to obtain.

In Britain a plant of this type has recently been installed at Falkirk[19] by the British Aluminum Co. and is built in two tiers. Strip up to 2 ft. in width being cleaned, anodized, rinsed, and dried by infrared at the rate of 10 ft. per min. before recoiling. A projected plant of this type will be able to process up to six 2″ ribbons simultaneously.

FINISHED PRODUCTS:

For anodizing finished products equipment essentially similar to automatic plating units can be employed. Such a plant was recently built for anodizing washing machine parts in 20% (vol.) sulphuric acid at 70°F., 16 volts, for 15 min.

In the pretreatment stages, the metal is cleaned in hot alkaline cleaner and etched in hot dilute hydro-

chloric acid while sealing is carried out in nickel acetate solution followed by a further hot water seal before drying in recirculated hot air.

The duplex carriage type of plant is 130 ft. long, 16 ft. wide (tank width 9 ft.) and 16 ft. high, while a second line 86 ft. x 4½ ft. x 4½ ft. high has been installed for stripping the contact points of the insulated aluminum alloy anodizing racks.

Two banks of six 1000 amp., 16 volt rectifiers are employed, and the lead cooling coils in the tank are employed as cathodes. This system has been adopted both in order to avoid the need for separate cathodes, and to give cathodic protection to the lead. The cooling coils consist of 1300 ft. of 1½ inch chemical lead and the cooling water is recirculated through a refrigeration unit. Fumes from the cleaning, anodizing and sealing tanks, are drawn below floor level; into trenches lined with acid resistant brick and covered with rubber lined steel plate. These trenches also carry the effluent into neutralization pits.

The thickness of the coating is limited, due to its relatively high solubility in the electrolyte and thicknesses of above 1.5 mil cannot be obtained without special techniques.

Coating Properties

The operating conditions influence the properties of the coating. Thus, the use of dilute solutions and lower temperatures favors harder coatings. while more concentrated solutions and increased temperature and operating time, i.e. those factors which favor the dissolution of the coating in the electrolyte, may produce coatings which are soft at the surface and, at the extreme, may be powdery or spongy and easily rubbed off. For this reason, also, the hardness and wear-resistance of a coating is not uniform throughout the film, but is lower nearer the surface.

Favorable conditions for the production of ductile coatings are described in two of the basic patents for the sulphuric acid process[24,25] using a low current density, e.g. 4 to 6 amp./ft.^{2} at 70 to 77°F. for 20 to 30 minutes in a 9% (w/w) solution of sulphuric acid. By using short treatment times, e.g. 4 to 5 minutes, iridescent coatings are also obtained.

Addition agents have also been suggested for the production of hard or soft coatings. Thus 15 to 20% glycerine[22] is in common use as an inhibitor to produce films of higher plasticity, as is the use of ammonium sulphate,[23] while other addition agents proposed include chromates and colloids in order to increase the uniformity of the coating, and oxalic acid to decrease the solubility of the coating and hence increase its hardness and limiting thickness. Oxalic acid has been added to sulphuric acid electrolytes and has been found to increase the life of the bath as well as giving, under some conditions, more compact coatings. Softer coatings are obtained by addition of wetting agents, e.g. aromatic sulphonic acids, which may also help to prevent spray, while methyl esters or cellulose have been suggested for harder coatings. Other addition agents such as lead acetate and potassium dichromate, lead acetate and ammonium chloride, sodium thiosulphate with rhodammonium or with potassium dichromate and ammonium sulphate have been added to produce colored coatings.

The British Standard Process

The British Standard sulphuric acid process is given in DTD 910C and this recommends a solution containing 18 to 22% sulphuric acid. The commercially pure acid should be used, which must contain not more than 0.02% sodium chloride. The water supply should also be free from chlorides. The bath is kept at 20°C. (± 2°C.) and the original solution should be of specific gravity 1.21 to 1.25 at 15.5°C. (25.16 to 29.00° Bé). Equipment is provided for cooling the solution as well as for agitation and filtration as described above.

A lead lined tank is used, and this may either serve as cathode or lead plates may be employed. The current should not exceed 0.8 amp. per gallon of solution. The bath voltage is 12 to 14 volts and the treatment time between 15 and 30 minutes.

After anodizing, the work is washed in cold, clean running water, and immersed in clean boiling water for a few seconds and dried. Subsequently, if it is not to be dyed, the coating is inspected before sealing. For this purpose, the film is dried and methyl violet is applied in the form of stamp ink on a rubber pad, or by a copying pencil over the moistened surface. No appreciable loss of color should result now by rubbing the work with a damp cloth.

The sulphuric acid process is not used in the case of assembled parts subject to stress, and containing recesses or joints in which retained traces of acids may cause corrosion.

(*To be Continued*)

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Methods of Coating Plastics with Metal

By John Keating, *Technical Service Department, Oakite Products, Inc., New York, N. Y.*

A VARIETY of methods has been reported for the coating of plastics with metals. Most of these have proved unsatisfactory or of limited application because of expense, poor adhesion, porosity of coating, poor mechanical properties, or other reasons. All of the methods involve a number of steps and some require special and expensive equipment. Extreme cleanliness and strict adherence to the procedures are indispensable requirements for success.

The methods of plating metals on plastics may be divided into those which apply the metal by electroplating and those which do not. In the electroplating methods, the surface of the plastic must first be made conductive. The methods used for this purpose include application of waxes and then coats of graphite; application of lacquers or varnishes containing metal powders; chemical reaction to give an electrically conductive compound; and chemical reduction to give a metal film. The methods which apply the metal without electroplating include metal spraying, vacuum deposition, and chemical reduction. Metal films deposited by metal spraying or vacuum deposition may subsequently be electroplated.

Producing a silver film by chemical reduction is probably the method most widely used for coating plastics with metals. This is the oldest successful method. (Of late, the production of a copper conductive coating by chemical reduction has come into prominence.) When properly applied to a clean, smooth surface, a mirror coating of silver can be obtained. The major application for this film is as a conductive coat for electroplating. In this process, plastic is sensitized with a specialized solution and then silvered with a mixture composed of an ammoniacal silver nitrate and a reducing solution. Small pieces, such as jewelry, are handled in quantity by immersion in the silvering solution. Large pieces are usually coated by spraying them with a special gun in which the silvering solution and reducer are mixed.

Preparation of a Plastic for Metal Coating

If the surface of a plastic or other material (e.g., leather, wood, certain ceramics) is porous, it is necessary to fill the pores in the surface before electroplating can be attempted. The pores may be closed by an application of wax, varnish, or shellac, etc.

Non-porous plastics also usually require special preparation depending on the thickness of the metal coating to be applied and the conditions to which the finished object will be subjected. Proper application can insure good adhesion, even if the metal coating is thin and the surface smooth. For the production of mirrors or decoratively reflective coats where the surface will not be abraded or where lacquering or other protection can be applied, a mirror-smooth plastic surface is entirely satisfactory. A very thin metal film, even though mirror-like and highly adherent is nevertheless very porous.

Adhesion is usually improved by roughening or etching the plastic surface. Both mechanical and chemical methods are used. The most common mechanical methods are blasting with abrasive and tumbling in a barrel with abrasive, adjusting the type and size of abrasive grain to the particular plastic, type and thickness of the metal to be plated, etc. Chemical etching materials are oxidizing acids, caustic solutions, and organic solvents.

The etching material, its concentration, and the time of treatment have to be adjusted to the particular plastic. Since a smooth surface finish is usually required on the plated metal, the roughening should be held to the minimum necessary to secure satisfactory adhesion. Deep crevices will naturally require thick plated layers and extra cutting down during buffing to produce a smooth surface. Actually this operation is a de-polishing one.

Electroplating Plastics

Low conductivity produces a non-uniform electroplated coating. Deposition starts at the cathode contact and gradually spreads. This effect may be partially overcome by making a number of fine wire contacts prior to electroplating. If the conductivity is too low, the conductive layer sometimes strips off before the plating has covered the entire surface. The suitability of conductive coats for electroplating may be tested with an ohmmeter.

Minor variations are made in the electroplating process which changes it slightly from standard practice. Since the conductive coat is very thin, a very high current density cannot be used initially on a large piece unless a number of contacts are made for distribution of the current. Hot baths should be avoided because they often soften and distort some plastics. Also, since the conductive coat is usually porous, highly acidic or highly alkaline plating baths cannot be used on all plastics. The usual barrel plating procedures may be used for small pieces.

Plating on plastics is naturally more expensive than plating on metal surfaces, since the plastic surface has to be made conductive. The cost is increased because of the conductive coat and also because the metal deposits on plastics are usually thicker than deposits on metal. These differences increase cost of metal, electricity, and labor. The length of electroplating time and the thickness of the plate depend upon the end use and properties of the finished piece.

Adhesion of Metal Layers on Plastics

Some of the recently developed industrial uses of electroplated plastics demand excellent adhesion under extreme temperature and humidity variations. Since metals and plastics differ so greatly in chemical nature, there is no natural adhesion between the two. For this reason, mechanical interlocking methods such as roughening of the plastic must be used. Even with such preparations, it is difficult (because of the different coefficients of expansion of metals and plastics) to obtain good adhesion if the metal is to have appreciable thickness. To effect such adhesion, special conditions must be established — the design of the plastic, for instance, is very important. Sharp edges, corners, or lines provide sources of much trouble. Such edges are difficult to make conductive, because the coating is exposed to the greatest amount of contact at these points permitting the coating to be rubbed off easily. The plated metal is easily cut through during polishing, and the metal may split here after the plated piece is put into service. Whenever possible, the design of the plastic article which is to be plated should incorporate the maximum number of interlocks such as grooves and indentations and the fewest possible areas of smooth, flat surfaces.

In most plastic-metal combinations, there are one or more intermediate layers between the metal and the plastic. The most common such layer is a conductive coat, such as chemically reduced silver, which must be applied before electroplating. These intermediate layers are responsible for the presence or absence of adhesion. If these layers do not adhere to the metal and to the plastic, the bond will be weak. Maximum adhesion is dependent on the formation of an interlayer which is stronger than at least one of the materials joined. To effect such an ideal situation, the following conditions must be present:

a. No weak interlayers, such as dirt or grease, etc., should be present because of improper cleaning or preparation.

b. No weak interlayers, such as non-adhering powder, should be present because of improper application of the conductive layer or improper plating.

c. All intermediate layers must be joined to neighboring layers by bonds stronger than the adhesive strength of the weaker material of the two to be joined. The bonds between the layers may be mechanical, effected by the interlocking of rough surfaces, or valance forces set up by the specific attraction between the two materials.

Cleaning of Plastics Prior to Metal Coating

The metal coating of plastics involves applying two or more layers to the plastic surface. The adhesion of the final plate will be very poor if the plastic has not been properly cleaned. Before attempting to process the plastic pieces, inspection should be made for foreign material, such as waxes, buffing compounds, mold lubricants, etc. These foreign materials must be removed before the plastics can be processed. Three methods for cleaning plastics are:

a. Washing with aqueous detergent solutions such as alkaline detergent, soap, synthetic detergent, etc.

b. Cleaning with organic solvents.

c. removal of the top layer of plastic with the resultant removal of adhering dirt.

Tumbling in pumice or other abrasive powder removes the surface soil but this necessitates cleaning to remove any remnants of abrasive powder which may be left on the surface of the plastic. The no-water-break surface test may be used with some plastics to check for thorough cleaning.

It is most important to thoroughly rinse all of the remaining soils and all of the cleaning material from the plastics after cleaning to prevent them from possibly interfering in subsequent chemical reactions.

Roughening of Plastics for Metal Coating

The most widely used method of improving adhesion of a metal coating to plastic is to roughen or etch the surface. Since a smooth surface finish is usually desired on the plated metal, the roughening should be kept to a minimum necessary to secure satisfactory adhesion. Often, removal of the surface shine is sufficient to produce good adhesion.

Roughening also serves to clean the surface. If a large amuont of soil, especially wax or grease, is present, a cleaning operation prior to tumbling is preferable to avoid contaminating the abrasive or etching material too quickly.

Mechanical roughening with abrasive (also called ashing) is a general method which may be applied to any surface and which requires very little adjustment to the nature of the plastic. Mechanical roughening is especially suitable where sharp corners, edges or lines are present on the surface of the plastic.

Solvent or chemical etching is highly specific and must be adjusted to each plastic. It seldom offers advantages over mechanical roughening.

Mechanical roughening is accomplished by impact of an abrasive. The size and nature of the abrasive grain is very important if the article is to be plated. In general, it should be small and sharp. Large size abrasive grains produce deep indentations in the plastic, necessitating thicker electrodeposits and more buffing to produce a high surface finish. Sharp abrasive is desirable to produce jagged depressions which give better anchorage to the metal than rounded depressions. There are three general methods for abrasive roughening:

a. Blasting with the abrasive. The abrasive may be carried along in a stream of air or liquid, or thrown upon the work by centrifugal action.

b. Tumbling in a barrel with the abrasive. This may be done wet or dry.

c. Rubbing with abrasive coated papers, cloths, etc. This may also be done wet or dry.

BLASTING WITH ABRASIVE:

Aluminum oxide and silicon carbide are excellent abrasives for this purpose. Garnet, emery, sand, etc., can also be used. For general purposes, #220 mesh abrasive is satisfactory. Smaller sizes are preferred for preservation of fine detail. Two types of equipment can

be used; air blasters, usually called sand blasters, and centrifugal blasters.

Tumbling with Abrasive:

This method is best suited for small parts, such as jewelry. A mild abrasive is used. For most purposes, pumice is suitable. If the work has indentations, small sharpened wooden pegs are added to the pumice so that the pumice can reach all of the crevices. Tumbling can be done dry or wet. Wet tumbling is more rapid, but certain plastics respond better to the dry tumbling process.

Use of Abrasive Coated Cloth or Paper:

This method of abrasive roughening is best applied to flat surfaces. The plastic sample may be rubbed against an abrasive cloth or paper lying on a flat surface, or it can be held against a moving abrasive belt or flat disc. To avoid overheating the surface of the plastic, it is best to do belt or disc sanding in a wet condition.

The main disadvantage to this method is the high cost of manual labor which is involved.

Silver Immersion Coatings

The silver coating is applied by precipitation of metallic silver as a result of a chemical reaction between the silver salt and the reducing agent. The process consists of two stages: sensitizing, during which a catalytic film is applied; and reduction, during which the silver film is applied. These reactions must be very carefully controlled to produce the silver in just the correct physical form.

Although both catalytic and silver films are strong and tenacious, they are very thin, so that the pieces should be handled gently in all steps. The reaction is very sensitive to impurities and changes in conditions so that care must be exercised.

The work must be thoroughly cleaned in preparation for receiving the silver conductive coat. If pumice or other roughening powders are used, or if chemical etching methods are employed, the work must be thoroughly cleaned and rinsed. The pieces must have a no-water-break surface to be sure of adequate cleanliness. The first step in actual preparation for receiving a silver conductive coat is sensitizing. This is the process which acts as a catalyst so that the silver may be reduced on the plastic surface. A typical sensitizing solution is basically stannous chloride dissolved in a solution of hydrochloric acid. After a thorough washing in plain water, the pieces are treated with ammoniacal silver solution and a reducer solution which produces metallic silver on the surface. The pieces are then thoroughly washed and allowed to dry to permit the silver coating to become stronger and to help evaporate some of the excess moisture which may have been absorbed by the plastic. After suitable drying time, the pieces are ready for electroplating.

Electroplating Baths for Use on Plastics

Once the surface of the plastic has been made conductive, the piece can be electroplated with standard baths and by standard procedures, with minor variations.

Temperature:

Since there is a great difference in the coefficients of expansion of metal and plastic, temperature plays an important role in plating. High-temperature plating baths will plate the plastic in expanded form, so that on subsequent exposure to cooler temperatures a blister may form in the plate. The greater the difference in the coefficients of expansion of metal and plastic, the greater the chance for such failure. Therefore, the temperature of plating should be the lowest possible consistent with the desired results, such as speed of plating, brightness, etc. Thermoplastics must be plated at lower temperatures than thermosetting plastics because of the higher coefficients of expansion. Cellulose acetate has one of the highest coefficients of expansion; therefore, it must be plated below 95°F. Phenol-formaldehyde plastics can be plated up to 129°F.

Current Density:

All conductive coats have a much lower conductive capacity than solid metal. If a large amount of current is passed through a contact into the conductive coat, local heating takes place, resulting in oxidation and other deterioration which is commonly called "burning." Also, if the object is large, the high voltage drop associated with a large current may cause the object to become bipolar, resulting in stripping of the conductive coat from areas distant from the contact point. Therefore, the starting current density should be small. A good practice is to use half the normal current density for the first few minutes and then increase the current density to the normal value.

Type of Plating Bath:

There are several limitations on the types of plating baths which are suitable. Since there are temperature limitations, the baths must, for example, be kept within specific ranges of temperature.

Most conductive coats do not have the cohesion of plated metal. If gassing takes place in the initial stage of plating, the conductive coat may be lifted or scoured off in spots before a sufficient metal has been plated to anchor it. For this reason, most conductive coats cannot be plated directly with chromium or gold. Also, most alkaline baths usually cannot be used, e.g., cyanide copper, rochelle copper, alkaline tin, brass, and cyanide zinc. However, silver cyanide plating baths are entirely satisfactory because no gassing occurs. If it is desired to plate from any of the questionable baths, a flash coat in a suitable bath will be necessary. For this purpose, acid copper, nickel, and silver are good.

Some plating baths are not suitable for plating plastics because of their high acidity or high alkalinity. A highly acidic bath may dissolve portions of the conductive coat before it is completely plated. If a copper conductive coat is used, plating must be started in a neutral or alkaline bath, e.g., nickel or silver. A highly alkaline bath may harm some plastics, such as cellulose acetate and other cellulose esters, and some phenolic plastics. The effect of the bath is best determined by immersing a piece of uncoated plastic in the plating bath overnight, and then comparing its physical appearance, surface hardness, and dimensions with an untreated piece.

(*Concluded on page* 85)

Electrodeposition of Nickel from Fluoborate Solutions

By C. B. F. Young, Ph.D. and William Strobach, M.Ch.E.

This is the third and final installment of the series by Dr. Young and Mr. Strobach. Part I appeared in July, and Part II in the August issue.—Ed.

Surface Tension Determinations with Wetting Agents

Since the preliminary work, after further samples of wetting agents had been obtained, had shown five of the selected materials to be compatible with the nickel fluoborate solution, it was decided to test these further to determine if the surface tension could be reduced to about 35 dynes/cm. and what concentration would be required to effect this result. These tests were conducted as follows:

1. 25 ml. of the stock fluoborate solution, containing 80 g./l. metallic nickel, 30 g./l. free boric acid, and Cl to the equivalent of 15 g./l. nickel chloride were used.
2. To this successive portions of the 5% wetting agent solution were added and the surface tension measured by the stalagmometer after each addition.
3. The temperature of all tests was held at 25°C.
4. The pH of the solution was 2.5 (MCP). No change in pH occurred due to the addition of any of the wetting agents in the amounts employed.

The results of the tests are plotted on Fig. 11. It is seen that the surface tension with Brij 35 leveled off at 43.6 dynes/cm. whereas 0.50% of the Tergitol 08 was required to reduce it to 37.2 dynes/cm. These two materials were therefore eliminated from further consideration at this time.

Triton N-100, a non-ionic alkyl aryl polyether alcohol and Triton 720, an anionic sodium salt of alkyl aryl polyester sulfonate, were found to be promising, only about 0.05% of either being sufficient to depress the surface tension to the desired value. Duponol 80, an anionic sodium n-octyl sulfate, was also found satisfactory in this respect at a concentration of 0.20-0.25% which the preliminary compatibility test had shown to be below the limit of solubility at normal operating temperature. Indeed, the latter material may logically be that of choice inasmuch as it is so similar in nature to the sodium lauryl sulfate so extensively used.

In any event, the abovenamed three materials are those with which further tests were conducted. The latter work was combined with the concluding investigations directed toward developing a suitable bright nickel formulation and will be described under that heading.

Preliminary Investigation of Brighteners

The several proprietary bright nickel solutions on the market attest to the many advantages of obtaining a bright deposit directly as plated. The possibility of formulating a bright nickel fluoborate solution was therefore investigated. The initial work directed toward this end will be now described and the final, concluding investigation in this direction will be covered in a later section.

TESTS WITH SACCHARIN:

As previously stated, the use of saccharin as a brightener had been suggested by the vendor of the nickel fluoborate concentrate, to the extent of about 0.5 g./l., additions to be made as determined by the appearance of a test plate.

Accordingly, a solution was prepared containing 60 g./l. metallic nickel, chloride to the extent of 15 g./l. $NiCl_2 \cdot 6H_2O$, and about 20 g./l. free H_3BO_3, and the pH was 2.4 (MCP). A Hull cell plate and cylindrical cath-

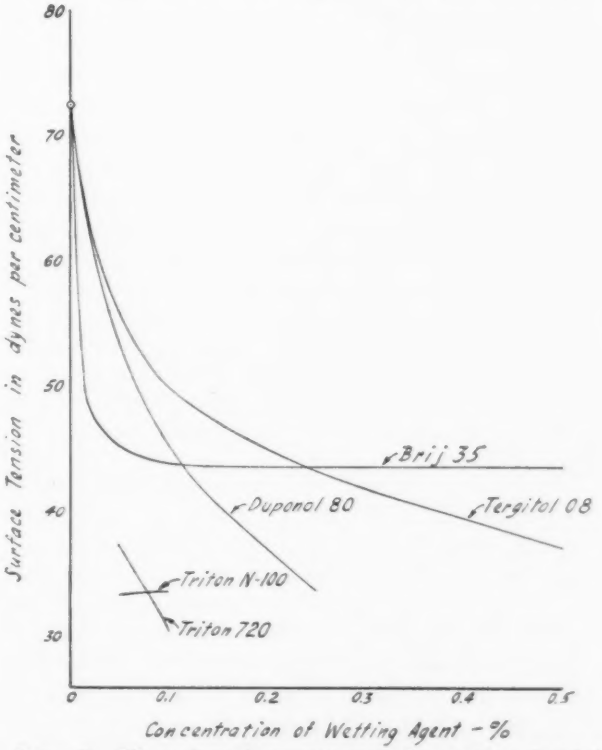


Figure 11. Effect of wetting agents on surface tension of nickel fluoborate solution.
Metallic Ni = 80 g/l (10.7 oz./gal.)
$NiCl_2 \cdot 6H_2O$ = 15 g/l (2 oz./gal.)
Free H_3BO_3 = 30 g/l (4 oz./gal.)
pH = 2.5 colorimetric
Surface Tension = 72.4 dynes/cm. as prepared.

ode specimen were plated from the solution as prepared.

The addition of 0.5 g./l. of saccharin, introduced as a solution in distilled water containing 0.05 g./ml., resulted in a somewhat brighter, but still hazy, deposit on a cylindrical specimen and an increase in the current density range at which a semi-bright deposit was obtained by the Hull cell. Temperature of 45°C. and 65°C. showed very little difference on Hull cell tests or on cylinders plated at 20 amp./sq. ft. Pitting was more or less evident in all tests.

An additional amount of saccharin equivalent again to 0.5 g./l. was introduced and the subsequent Hull cell test showed an improvement in the range at which a semi-bright deposit could be obtained. Pitting was still encountered. An addition of 0.3 ml. of 100-volume H_2O_2 was made, the solution heated to 100°C. for 3 minutes, and filtered. The solution had become quite cloudy while the solution was being heated and filtered slowly, the filtrate being clear. A Hull cell test did not evidence pitting and there was no appreciable difference in appearance of the plate otherwise.

It was decided to raise the pH by the addition of nickel carbonate, the temperature increased to 100°C. to expel the CO_2 from the solution, after which it was filtered without the use of filter aid. The pH, read with chlorphenol red, was about 5.0. A Hull cell test showed a slight lowering in the semi-bright plating range with pitting again being present. A cylindrical specimen plated at 20 amp./sq. ft., was semi-bright but badly pitted, although the cathode efficiency was appreciably higher than previous tests at the lower pH.

It was decided to try adding a wetting agent and Duponol ME Dry was chosen. The addition of a quantity equivalent to 0.5 g./l. decreased the surface tension from 72.7 to 28.5 dynes/cm. at 25°C. A Hull cell panel and cylindrical specimen showed the absence of any pits but the deposit was only matte in character.

Another 0.5 g./l. saccharin was again added and the Hull cell tests repeated, both with copper and steel cathodes. In both cases, the Hull cell plates exhibited a semi-bright plating range up to about 70 amp./sq. ft. and the cylindrical cathodes were also fairly bright with pitting or streaking being absent. The brightness did not approach the brilliancy normally obtained with the commercial bright nickel sulfate bath. One final cylindrical specimen was plated from this solution at a current density of 100 amp./sq. ft. and to a thickness of about 0.005″ for use on Knoop hardness tests.

Tests with Addition Agents of Commercial Bright Nickel Solution:

The several addition agents used with the commercial bright nickel sulfate solution included in this investigation were available and it was decided to make some tests with them by adding them to the fluoborate solution in the proportions used in the sulfate bath. The purpose of these particular tests was primarily to determine whether the fluoborate formulation is amenable to brightening by the same agents even though the identity of the latter may not definitely be established herein.

Three addition agents are used; two, which will be identified as #1 and #2, are used as brighteners while the third, here called #3, is a wetting agent. Three series of tests with different solutions, termed J, K and L, were run.

Tests with Solution J

A solution was prepared containing the same metallic nickel and free boric acid content as the bright sulfate solution, namely 80 g./l. and 37.5 g./l. respectively. No chloride was added and the pH was about 2.0. The two brighteners were added first, #1 as a liquid to the extent of 0.125% by volume and #2 as a solid to the extent of 6.0 g./l., the proportions being the same as normally used for the sulfate bath. Likewise, 0.6 g./l. of the wetting agent was then added whereupon the solution which had been perfectly clear developed a cloudiness. The solution, which had been heated to about 70°C., was cooled to 50°C. and filtered, the filtrate still being hazy. A subsequent cooling to 25°C. and filtration resulted in a solution which was only very slightly opalescent.

The surface tension of this solution was found to be 38.0 dynes/cm. at 25°C. About 15 minutes after the last filtration and with the temperature at 25°C., a considerable quantity of fine crystals formed in the solution. These redissolved on heating to about 30-35°C. although the solution remained opalescent.

Some tests showed streaked deposits although the general character of the plate was fairly bright and there was no pitting. In the last of the Hull cell tests conducted at relatively high average current density, there was considerable gassing at the anode and a noticeable halogen-like odor was given off.

The pH was increased to about 4.6 (BCG) by means of nickel carbonate, solution being heated to 70°C. for 30 minutes and then filtered. The surface tension of the solution was thereupon determined as only 55.8 dynes/cm. at 25°C. Hull cell plates were run at the same temperature and current densities as before and both still showed the same condition of a generally fairly bright plate marked with slightly hazy areas and also considerably pitted. Much frothing and the same distinct odor of halogens was again encountered with the rather high value of current that was used. Also, it was noted that the pH dropped 0.2-0.3 pH unit during both of the latter tests as expected, since the average anode efficiency undoubtedly was less than that at the cathode during these tests. A cylindrical cathode test demonstrated again that a higher cathode efficiency is obtained at higher pH.

The pH was then reduced to 3.5 (BPB) by addition of HBF_4. Tests were then run, obtaining an intermediate cathode efficiency between those obtained at lower and higher pH values and a deposit that was quite bright though pitted considerably. A Hull cell test gave results quite similar to that obtained at the higher pH although pitting was somewhat less and the general background somewhat brighter and less hazy. Pitting, however, was still evidenced.

Tests with Solution K

Solution K was prepared similarly to Solution J, except that instead of using the wetting agent provided for the commercial bright nickel sulfate solution, Duponol ME Dry was employed.

After the addition of the two brighteners but before introducing the wetting agent, the surface tension of the solution was determined as 63.7 dynes/cm. at 25°C. showing that, although the brightening agents reduce the surface tension somewhat, their effect in this respect is insufficient to prevent pitting. This was confirmed by conducting tests before and after the Duponol ME Dry was added. The surface tension after the addition of 0.35 g./l. of the latter material decreased to 34.4 dynes/cm. at 25°C. A faint cloudiness was produced in the originally clear solution when the wetting agent, dissolved in a small quantity of distilled water, was introduced and this haze persisted after a filtration at 50°C. and subsequent heating to 75°C. This haziness of the solution undoubtedly resulted in the haziness of the deposit obtained from it which marred its otherwise bright surface. The pronounced, halogen-like odor emitted from the solution when used at the relatively high current densities, with gassing at the anode particularly, was evident with this formulation.

It was now decided to add chloride to the solution to study its effect on both of the conditions it was desired to eliminate, namely that of the haziness of the solution and deposit and that of the excessive gassing at the anode with its accompanying fume nuisance and low anode efficiency. Therefore, nickel chloride was added to the extent of 15 g./l. and corresponding adjustments made to maintain the metallic nickel and free boric acid content at the same figures as before. The haziness of the solution persisted after this addition and subsequent filtration.

During the subsequent test, conducted at the same current density as for the previous Hull cell tests, there was no gassing evident at the anode and no odors emitted from the solution. The anode was quite dark after the test. An appreciable drop in cell voltage occurred, amounting to about 15% less than the voltage previously required. There was no noticeable improvement in the appearance of the plate.

The solution was heated at 75°C. and filtered. The surface tension measured 39.4 dynes/cm. at 25°C. Another Hull cell test and a cylindrical specimen were then run. Both showed a somewhat less overall brightness and the same condition of haziness. The anode was dark after the Hull cell test, but no halogen-like odors were noticed.

Tests with Solution L

It was next decided to make up a solution containing the same amount of chloride as the commercial bright nickel sulfate solution, namely 60 g./l. as $NiCl_2 \cdot 6H_2O$, also maintaining the same total metallic nickel and free boric acid concentration. A volume of such a solution, identified as Solution L was prepared and tests made with this. The same concentration of the two brighteners were used and Duponol ME Dry was added to the same extent, 0.35 g./l. as in Solution K. The surface tension of the solution as prepared was 28.4 dynes/cm. at 25°C. and the pH was read as about 2.0 (MCP).

A cylindrical specimen plated at a current density of 150 amp./sq. ft., resulted in the brightest and clearest deposit yet obtained from a fluoborate formulation. A sample was run at 300 amp./sq. ft. to a nominal thickness of 0.005" for Knoop hardness test. Hull cell tests were run on copper and steel cathodes, respectively, at the same relatively high current density employed in the majority of the tests in this series. Results on these were practically identical, the general appearance being quite bright with, however, a haziness in the low current density region up to about 30 amp./sq. ft. and streaked deposits in the range between about 225 to 400 amp./sq. ft. There was no gassing at the anode and only a relatively small amount of it at the high current density end of the cathode and no odors were emitted from the solution. A dark anode film was observed after the tests.

Two more Hull cell plates were run at temperatures about 10°C. above and below those used in the preceding tests. The same condition of a quite bright general appearance marred by areas where the deposit was hazy and/or streaky was obtained. No gassing occurred at the anode which was covered by a dark film after these tests.

Bent Cathode Tests

Bent cathode tests were conducted in a cell consisting of a one-liter beaker having an inside diameter of about 4 inches and height of about 6". The solution volume was 850 ml. so that the depth of solution was about 4.25 inches with the anode in place. The latter consisted of a section of a small commercial rolled, depolarized nickel anode, oval in cross section — about 1.5" x 0.375" and immersed to the full depth of solution or about 4.25" along the inside wall so that the exposed anode area was approximately 7.0 sq. in.

The cathode consisted of polished brass (70 Cu — 30 Zn) plates 1" x 4" x 0.032" thick, the bottom one inch being bent at a right angle. The cathode was suspended by means of a copper wire along the inside wall of the cell diametrically opposite the anode so that the inter-electrode distance was about 3.5" to the 1" x 3" face and cathode area included the 1" x 3" face and both the upper and bottom areas of the horizontal leg, each 1" x 1" or a total of 5 sq. in. so that the anode : cathode ratio was approximately 1.4 to 1. The cell was thermostatically controlled similarly to the other test apparatus used.

The cathodes were cleaned by the standard method adopted and plated in the solutions. Only a relatively few tests were made in this series and these primarily to obtain another means of comparison between the two sulfate baths and one or two fluoborate formulations. For the latter, the two one-liter solutions previously used in the Haring cell tests were employed. The former was Cl free, the latter contained 15 g./l. nickel chloride, and both contained 80 g./l. metallic nickel and 30 g./l. free boric acid. Two tests were conducted on each of these two solutions and two on each of the two sulfate solutions. The bath was stirred occasionally and gently while plating using a glass rod.

Insufficient samples were run to draw any very definite conclusions from these tests and, it is believed by the authors, this test is probably better suited to the evaluation of the bright nickel baths and probably requires considerable experience with any one solution for proper and full interpretation of the results ob-

tained with it. It should be mentioned that any irregularity of deposit at the low current density area at the bend was considerably more noticeable on plates from the fluoborate bath, which had a satin or almost semi-sheen background than on plates from a solution such as the Watts which gave a generally duller, more matte deposit.

It was again found that the voltage requirements for the fluoborate solutions are only about 60% of those needed to obtain the same current densities from the sulfate solutions when operated at similar temperatures. During tests made with a fluoborate solution containing no Cl, there was considerable and constant gassing at the anode.

Concluding Investigation on Development of Bright Nickel Fluoborate Formulation Incorporating a Wetting Agent

Preliminary tests on wetting agents had shown that, of those investigated, there were three which were promising for use with the fluoborates, namely Duponol 80, Triton 100, and Triton 720. Other tests had indicated that fairly bright, or at least semi-bright, deposits could be obtained from nickel fluoborate baths containing saccharin or some of the proprietary brighteners supplied for the bright sulfate baths, but that the wetting agents so far tried with them had usually resulted in hazy or streaked areas in the deposit.

A further study of the literature disclosed that Young from an investigation of various patents issued on bright nickel formulations found that, among other agents, para toluene sulfonamide was used as a brightener and a recent article by Sirota, while primarily on the determination of paratoluene sulfonamide in nickel plating baths, gives the concentration of this compound in various nickel plating solutions tested as about 0.6 to 2.0 g./l.

It was therefore decided to conduct a final series of tests on the formulation of a nickel fluoborate bath which would include as wetting agent one of those mentioned above and as brightener either para toluene sulfonamide or saccharin or, possibly, a combination of these two closely allied chemicals.

The basic formulation chosen was 80 g./l. metallic nickel, 15 g./l. nickel chloride, and 30 g./l. free boric acid, which previous tests had shown to be a good one, and the conditions of pH and temperature selected were 3.0 and 60°C. respectively, also on the basis of the previous experiments. The solution was adjusted to a pH of 3.0 (brom phenol blue) by addition of 10 grams of nickel carbonate, purified by a carbon treatment and, after filtration, was electrolyzed with a "dummy" corrugated brass cathode at an average current density of first five and then 20 amp./sq. ft. for a period of two hours each at 60°C. A check analysis showed 79.5 g./l. metallic nickel and the surface tension was determined as 73.0 dynes/cm. at 25°C.

Four portions of the solution were withdrawn, three for use separately with the three wetting agents above and the fourth for preliminary tests with PTS (para toluene sulfonamide).

Initial plating tests were made with the Hull cell using five amperes current flow for four minutes at 60°C. It was found that Triton 720 gave a dark, streaked, and rough deposit and this agent was, therefore, eliminated from further trials. The other two wetting agents gave plates that were free of pits, whereas the plate from a solution without addition exhibited many pits. In other respects, these three plates were very similar. There was no gassing at the anode during any of the tests and all solutions remained clear.

The next series of tests was made by first adding three successive amounts of PTS (para toluene sulfonamide — Monsanto), each equivalent to 0.5 g./l., after which saccharin was added to an amount of 0.5 g./l. Hull cell panels were run after each addition with the 1.5 g./l. PTS addition showing to the best advantage. In all cases, the PTS was added as a solution in hot distilled water, about 10 ml. being required to dissolve two-tenths grams at 60°C., and the saccharin was added as a solution at a concentration of 0.05 g./ml.

Since the addition of 1.5 g./l. of PTS had been found to give the best results so far, this concentration was added to each of solutions containing Duponol 80 and Triton N100 respectively. Both remained clear and the surface tension readings showed little effect as a result of the addition. The Hull cell test, however, gave a bad plate, being dark and very streaked all over and somewhat rough at the higher current density range. Triton N-100 was, therefore, eliminated from further consideration leaving Duponol 80 as the best choice of wetting agent. The test combining it with para toluene sulfonamide proved to be quite good showing a fairly bright plate over the entire range up to 275 amp./sq. ft., without pitting. However, the plate did not have the full smoothness and brilliance usually associated with deposits from the commercial bright nickel sulfate solution.

Further tests were conducted with the following results:

(a) Three cylindrical cathode specimens were plated at 60°C. and 150 amp./sq. ft., two to a thickness of 0.001" one being brass and the other steel, and one to a thickness of 0.005" on brass for use in the determination of Knoop hardness numbers. These tests gave good results. The two 0.001" deposits had practically equivalent smoothness and brightness to those normally obtained from the bright sulfate solution. Cathode efficiency was about 99%.

(b) Two steel panels of the type used for impact tests were plated in the apparatus described. One was plated at 20 amp./sq. ft. and the other at 150 amp./sq. ft. The conditions used and results obtained were as follows:

	PANEL 1	*PANEL 2*
Temperature	60°C.	60°C.
pH	3.0	3.0
Current Density	20 amps./sq. ft.	150 amps./sq. ft.
Amperes	1.05	7.88
Volts	1.50	7.25
Minutes	28.5	3.8
Nominal Thickness	0.0005"	0.0005"
Wt. of Deposit	0.530 gram	0.542 gram
Cathode Efficiency	97.0%	99.0%
Dissolved from Anode	0.544 gram	0.547 gram
Anode Efficiency	99.5%	100.0%
Result of Impact Test	Good adhesion. No cracking of deposit	Good adhesion. No cracking of deposit.

The anodes acquired a dark brown film during the tests. Cathode and anode efficiencies were in line with values obtained on solutions of similar composition without addition agents when operated under similar conditions. Results of the impact tests were good.

(c) Three Hull cell tests were run and again, although results were quite good, the full brightness usually obtained with the bright sulfate solution over the entire range of current densities up to about 150 amp./sq. ft. was not attained in these tests. A few pits appeared in the first of these three panels. The surface tension of the solution had risen to 41.5 dynes/cm. at 25°C. Eight ml. of a 5% solution of Duponol 80 were added, decreasing the surface tension to 35.5 dynes/cm. The two subsequent panels were found to be free of pits. This indicated again that the surface tension of the nickel fluoborate bath should be maintained at a value of about 35 dynes/cm. at 25°C. The solution, after all the tests were completed, was perfectly clear and had a pH of 3.1 (brom phenol blue).

(d) Throwing power tests were conducted using the same Haring cell and technic previously described. Tests were conducted at current densities of 20 amp./sq. ft. and 150 amp./sq. ft. as follows:

1. Haring cell test at 20 amp./sq. ft.:

Temp.—60°C. pH—3.0
Amps.—1.05 Volts—1.12 Time—28.5 min.
Anode Loss—0.542 gram
Anode Efficiency—99.0%
Deposit on Near Cathode — 0.429 gram } Cathode Efficiency
Deposit on Far Cathode — 0.104 gram } —
97.6%
MDR—4.12 T.P.—17.6% T.E.—22.0%

2. Haring cell test at 150 amp./sq. ft.:

Temp.—60° pH—3.0
Amps.—7.88 Volts—4.15 Time—3.8 mins.
Anode Loss—0.549 gram
Anode Efficiency—100.4%
Deposit on Near Cathode — 0.450 gram } Cathode Efficiency
Deposit on Far Cathode— 0.096 gram } —
99.8%
MDR—4.68 T.P.—6.4% T.E.—8.0%

These tests show comparable results with those previously obtained for a similar fluoborate formulation free of addition agents.

Investigation of Nickel-Cobalt Fluoborate Solution

It had originally been intended to make a rather extended investigation into the possibility of formulating a nickel-cobalt fluoborate solution. However, the scarcity of information available on the nickel fluoborate bath itself necessitated devoting practically our entire attention to this bath alone to establish its properies and characteristics. Therefore, the main study of the cobalt and nickel-cobalt fluoborate solutions will be made the subject of future investigations. At the same time, a few preliminary tests were conducted on nickel-cobalt fluoborate formulations and these are described here.

A sample of cobalt fluoborate concentrate was obtained from the same vendor who furnished the nickel fluoborate concentrate. It was supplied in a paraffin-coated glass bottle as a reddish colored liquid having the following analysis and specific gravity:

Assay $Co(BF_4)_2$	47.05%
Co	11.92%
Free HBF_4	2.02%
Free H_3BO_3	4.69%
Specific Gravity at 25°C.	1.570

Two solutions were prepared, with a 19 Ni:1 Co ratio and with a 4 Ni:1 Co ratio. Details of the solution composition and of the cylindrical cathode and Hull cell tests conducted follow:

19:1 Ni:Co Ratio
Volume — 300 ml.

1. Formula

$Ni(BF_4)_2$ concentrate, 49.8%; Lot 1	127 grams
$Co(BF_4)_2$ concentrate, 47.05%	7.55 "
$NiCl_2 \cdot 6H_2O$	15 g./l.
Ni, metallic	57 "
Co, metallic	3 "
Ni:Co ratio	19:1
Free H_3BO_3	19.6 "
pH, colorimetric	2.4

2. Preparation

The nickel chloride was dissolved in about 100 ml. of distilled water, the metal concentrates added, and the volume adjusted to 300 ml. with distilled water. The free boric acid concentration of 19.6 g./l. was that due to the content of this constituent in the metal concentrates. The solution was heated to 70°C., 0.6 gram of carbon added, stirred occasionally for 15 minutes at the same temperature, and then filtered. The pH as prepared was 2.4 colorimetric.

3. Tests

Two cylindrical and one Hull cell test were run at 55°C. and low current densities. The deposits were quite similar in appearance to those obtained from the straight fluoborate solution under comparable conditions. Pitting was also encountered and cathode efficiencies were below 90%.

4:1 Ni:Co Ratio
Volume — 300 ml.

1. Formula

$Ni(BF_4)_2$ concentrate, 49.8%; Lot 1	105.5 grams
$Co(BF_4)_2$ concentrate, 47.05%	30.2 "
$NiCl_2 \cdot 6H_2O$	15 g./l.
Ni, metallic	48 "
Co, metallic	12 "
Total metal	60 "
Ni:Co ratio	4.1
Free H_3BO_3	20 "
pH, colorimetric	2.4

2. Preparation

The quantities of the two metal concentrates and the dissolved nickel chloride were diluted to 300 ml. with distilled water, the free boric acid concentration of 20 g./l. being that due to the content of this constituent in the metal concentrates. A preliminary test indicated that the pH was about 1.9 colorimetric, which was adjusted to 2.4.

3. Tests

Three cylindrical and two Hull cell tests were made. The deposits were dark at low current densities and bright or semi-bright at higher current densities. Pitting was evident, particularly at current densities of 40 amp./sq. ft. and up, and was reduced, although not eliminated, by a treatment with hydrogen peroxide. Current efficiencies ranged from about 85% at 20 amp./sq. ft. to about 90% at 100 amp./sq. ft. Cell voltages in the Hull cell tests were appreciably higher than those for straight nickel fluoborate solutions under similar conditions.

Determination of Knoop Hardness Numbers

One of the Tukon hardness testers using the Knoop indenter was available and it was decided to make hardness determinations with this apparatus on representative samples of the present work. The samples used for these tests are those cylindrical specimens that had been plated with a nominal 0.005" thick deposit during the main investigation with the various solutions.

A section cut from near the center of the cylinder was mounted in Bakelite and taken through the regular steps of polishing as for a metallographic specimen. The Knoop diamond indenter was then applied on the cross section near the center of the nickel deposit using a 200-gram load, similarly to the procedure used at the U. S. National Bureau of Standards. Other measurements were made directly on the surface of the plate after giving it a very light buffing. Measurements of the indentions were made optically. Three tests were made on each sample on both the cross section and the outside surface with the length of identation expressed as Filar units. The latter were converted to millimeters, and then to Knoop numbers.

Results of the tests are summarized as follows:

1. In general, more consistent results were obtained on the cross section which is to be expected inasmuch as the cross-sectional surface was both flat and highly polished as contrasted with the cylindrical and relatively rough outer surface. At the same time, with the rather thick deposit (about 0.005") and the light load applied (200 grams), a fairly good indication of hardness may be obtained by means of tests made on the outer surface. However, the conclusions below are based on the determinations made on the cross sections.
2. The nickel as deposited from fluoborate solutions under the different conditions of composition and plating employed varied from 256 to 586 Knoop hardness.
3. The four samples tested which were plated from a fluoborate bath containing 80 g./l. metallic nickel and brightening and wetting agents at a temperature of 50-55°C. and pH of 2.0 to 3.5 varied only by about 20 hardness units from the mean value of 565 Knoop, using current densities of 100 to 300 amp./sq. ft. This is practically the same hardness as that of the deposits from the bright sulfate solution under the conditions employed.
4. The lowest hardness was obtained on deposits from solutions at relatively low pH.
5. Hardness increased at the higher current densities.
6. Hardness decreased with rise in temperature.

Thickness Determinations

The Aminco-Brenner Magne-Gage was employed to investigate the thickness and evenness of deposit on some of the cylindrical steel samples plated. Prior to using this instrument it was calibrated against a set of standard plates bearing coatings of known thicknesses furnished by the National Bureau of Standards. Two calibration curves were used, one covering the range from 0 to 0.00075" Ni and the other that from 0.0005" to 0.002" Ni.

The cathode efficiencies of the various tests during which the cylinders were plated were all of the order of 96 to 99% so that the average thickness of deposit necessarily was quite close to the nominal thickness for which the quantity of electricity in coulombs passed was calculated. In practically all cases, the actual thickness measured was somewhat less than the nominal at the center and somewhat above nominal at the top and bottom of the cylinders. The maximum deviation from the nominal thickness of the samples measured was about 16%.

Economic Considerations

The cost per gallon of electrolyte for a fluoborate bath having a metal content of 80 g./l. according to the bright formulation developed in the present work and for each of the two sulfate baths was calculated.

The addition agents for the fluoborate bath consist of 1.5 g./l. of para toluene sulfonamide and 0.20% of Duponol 80 and those for the bright sulfate solution are, of course, the ones applied for this bath at the recommended concentration.

The cost per gallon of the fluoborate solution was calculated at about three times that of the bright nickel sulfate solution and about five times that of the Watts solution. At the same time, it has previously been shown that up to three or four times as high current densities can be employed with the fluoborate solution as with sulfate solutions of comparable metal content. This means that the cost of solution volume actually required would probably average out the same. The capital investment should be considerably in favor of the fluoborate bath since correspondingly smaller tanks, accessory equipment, floor space, etc. would be required.

An additional saving can be realized in that tank voltage, and therefore power consumption, is only about 60% of that required for a sulfate bath of the same metal content. Everything considered, therefore, the economic aspects would seem to favor the fluoborate bath inasmuch as the lower operating costs required will more than balance out any higher initial cost.

The ability to formulate a bright or semi-bright fluoborate solution makes possible the economies to be derived from any bath giving bright rather than matte deposits.

Summary and Conclusions

1. The deposition of nickel from fluoborate solutions was explored covering the range of concentration from 50 to 120 g./l. of metallic nickel under varying conditions of temperature, pH, current density, and agitation.

2. The presence of chloride in the fluoborate bath was found to be beneficial, increasing both anode and cathode efficiencies and preventing objectionable gassing of the solution at the higher current densities. It is recommended that nickel fluoborate baths be formulated to contain at least 15 g./l. of nickel chloride.

3. The presence of an excess of free boric acid was found advantageous in that it aided in stabilizing the solution, preventing the formation of fluorides which otherwise might be formed under certain operating conditions. The inclusion of at least 30 g./l. of free boric acid is therefore recommended.

4. For general purposes a metal concentration of about 80 g./l. is recommended with an operating temperature of about 60°C. and pH of about 3.0 colorimetric. This combination will allow the use of cathode current densities up to about 200 amp./sq. ft. with anode and cathode efficiencies approaching 100%.

5. The use of a suitable wetting agent to control pitting is recommended. Of various materials tested Duponol 80 (sodium n-octyl sulfate) proved to be the best. The surface tension of the solution should preferably be maintained at about 35 dynes/cm. when measured at 25°C.

6. The bath was stable and readily kept in balance when operated under the recommended conditions. Normally the pH increased slightly during operation and was adjusted by the addition of fluoboric acid.

7. Limiting current densities were established as a function of metal content and temperature of the solution. Comparison was made against nickel sulfate solutions of typical Watts and bright nickel formulations. It was found that current densities from two to four times as great as those normally employed with nickel sulfate solutions of comparable metal content could be used.

8. Cathode efficiency was found to increase with increasing current density below the limiting value and with increasing pH in the range of 1 to 2, colorimetric. The efficiency drops off very rapidly below a pH of about 2.0, colorimetric.

9. The limiting current density is increased by cathode agitation. With a cathode rotating at a rate equivalent to a speed of about 100 feet per minute an increase of about 30% in limiting current density was obtained above that found for still plating.

10. Throwing power of nickel fluoborate solutions compared favorably with that of the sulfate solutions. In all cases throwing power decreased with increasing current density.

11. Impact tests showed that the deposits from fluoborate solutions at a pH of about 3.0 colorimetric and higher compared favorably with those obtained from a Watts solution with respect to ductility and adhesion. Nickel deposited from the bright sulfate solution proved to be relatively brittle by this test.

12. The deposits from nickel fluoborate solutions under proper conditions of operation were easily buffed and readily accepted a chromium plate.

13. Bright or semi-bright deposits were obtained from solutions containing saccharin or para toluene sulfonamide or a combination of the two. The brightest deposits were obtained on smooth, buffed brass from a solution containing paratoluene sulfonamide as the only brightening agent. Anode and cathode efficiencies and throwing power were not impaired by the use of this material and the deposits remained ductile.

14. Knoop hardness numbers were determined for deposits of 0.005" nominal thickness from fluoborate solutions and ranged from about 260 to 580 using a 200 gram load. The hardness was increased with higher current density, higher pH, and lower temperature. The Knoop hardness of bright or semi-bright deposits from a fluoborate solution containing 80 g./l. of metallic nickel and addition agents was similar to that of deposits from a bright sulfate solution of comparable metal content.

15. Although the cost of electrolyte is fairly high other considerations show the economic aspects of the use of nickel fluoborate solutions to be favorable.

METHODS OF COATING PLASTICS

(*Concluded from page* 78)

TANK PLATING:

Pieces larger than approximately 1½ inches and many others even smaller than this must be separately wired and plated in a tank. The conductive coat is usually very thin. Abrasion or contact with sharp corners or edges may penetrate it. Therefore, careful consideration must be given to the method of racking the article in the bath. More than one contact point is desired on small objects and necessary on large objects to insure alternate paths of the current if one contact point fails. The piece should not pivot on the contact points. To avoid swinging on the contact points, the cathode bar should not be moved during the first few minutes of plating.

BARREL PLATING:

Small objects can be plated in barrels. Oblique barrels are preferred for plating plastics so that the condition of the work will be visible at all times. Care must be taken not to wear off the conductive coat before it is completely plated with metal. If the pieces are sharp or have high edges, it is best at the beginning to rotate the barrel a half turn, stop for about 10 seconds, rotate the barrel again a half turn, stop, etc. Continue this intermittent rotation till all pieces have been covered with copper, which may take approximately 15 minutes. After coverage is complete, rotation may be continuous. Work not having sharp edges may be rotated immediately on starting the plating operation.

Preparation of Articles for Plating

The work should be completely wetted before placing in the plating tank. In most cases, the conductive coat wets readily on dipping into tap water. However, if there is a delay of more than one day between applying the conductive coat and the plating, the articles may have taken up sufficient oil and dirt from the atmosphere so as not to wet completely. In this case, agitation in a weak solution of wetting agent or in a weak solution of sodium cyanide is necessary before attempting to plate.

Science for Electroplaters

6. Valency

By L. Serota

This is the second half of Part VI. The first half appeared in the August issue.—Ed.

Metals and Non-Metals

The classification of elements into groups based upon the similarity of physical and chemical characteristices, as indicated by the electronic structure of the atoms and periodic arrangement of the elements, provides a satisfactory, though not a sharply defined, division into the elements known as metals and non-metals.

Elements classified as metals are those possessing few electrons in the valence shell. Such elements have a definite crystal lattice made up of positive ions and valence electrons. Such electrons are loosely bound and can move about freely, in a manner comparable to a liquid or gas. The attachment between valence electrons and the kernel which holds the crystal together is termed the metallic bond. When the valence electron(s) is stripped or transferred from the atom (metal) an electropositive kernel remains. Metals will, accordingly, form cations, as Ag^+, and sometimes a complex ion, as $Ag(CN)_2^-$. Non-metals, by such transfer, in gaining the electron(s) become electronegative and form anions, as Cl^-, with occasional complex anions as the fluoborate, BF_4^-, and the fluosilicate, $SiF_6^=$.

Metals, with few exceptions, form basic oxides which show basic properties when dissolved in water. For example, sodium oxide when dissolved in water (aqueous solution) will form the familiar base, sodium hydroxide. Some, as the oxides of zinc and aluminum, when dissolved in water, will show acid characteristics as well as basic (amphoteric) and the aqueous solutions of some oxides of the higher valent metals show acid properties. The oxide of the metal chromium, chromium trioxide, CrO_3, in solution is familiar to the plater as chromic acid. In solution, the chromic acid, H_2CrO_4, will very likely form dichromic acid $H_2Cr_2O_7$. Non-metals form acidic oxides which show acid properties when dissolved in water. A water solution of sulfur trioxide, SO_3, will give sulfuric acid H_2SO_4. The characteristics indicated are of a chemical nature.

Physical characteristics associated with elements grouped according to this division are:

LUSTER

Metals: All metals possess luster. With the exception of copper and gold, the color of the metals is silver and gray. In powder form only gold, bronze and aluminum are lustrous.

Non-metals: Do not possess luster with the exception of iodine and graphite.

ELECTRICAL CONDUCTIVITY

Metals: Good conductors. In the solid form, it is believed the loosely held electrons can move from one atom to another when an electric potential is applied. The best conductors are the metals copper, silver, gold (monovalent) belonging to Group Ib. Conductivity decreases for the divalent metals (two electrons in the valence shell) and is poorest for the higher valent metals. Conductivity decreases as the temperature increases.

Non-metals: Poor conductors. Graphite is the exception.

PERIODIC TABLE

PERIODS	GROUPS																	
	0	1 a	1 b	2 a	2 b	3 b	3 a	4 b	4 a	5 b	5 a	6 b	6 a	7 b	7 a	8		
I		H 1																
II	He 2	Li 3		Be 4		B 5		C 6		N 7		O 8		F 9				
III	Ne 10	Na 11		Mg 12		Al 13		Si 14		P 15		S 16		Cl 17				
IV Series 1	A 18	K 19		Ca 20		Sc 21		Ti 22		V 23		Cr 24		Mn 25		Fe 26	Co 27	Ni 28
Series 2			Cu 29		Zn 30		Ga 31		Ge 32		As 33		Se 34		Br 35			
V Series 1	Kr 36	Rb 37		Sr 38		Y 39		Zr 40		Nb 41		Mo 42		Tc 43		Ru 44	Rh 45	Pd 46
Series 2			Ag 47		Cd 48		In 49		Sn 50		Sb 51		Te 52		I 53			
VI Series 1	Xe 54	Cs 55		Ba 56		Rare earths[1] 57–71		Hf 72		Ta 73		W 74		Re 75		Os 76	Ir 77	Pt 78
Series 2			Au 79		Hg 80		Tl 81		Pb 82		Bi 83		Po 84		At 85			
VII Series 1	Rn 86	Fa 87		Ra 88		Actinides[2] 89–98												

[1] Lanthanides (Rare Earths): La 57, Ce 58, Pr 59, Nd 60, Pm 61, Sm 62, Eu 63, Gd 64, Tb 65, Dy 66, Ho 67, Er 68, Tm 69, Yb 70, Lu 71

[2] Actinides: Ac 89, Th 90, Pa 91, U 92, Np 93, Pu 94, Am 95, Cm 96, Bk 97, Cf 98

Figure 22.

THERMAL CONCUCTIVITY

Metals: Generally good conductors of heat.

Non-metals: Poor conductors.

DENSITY

Metals: Compactness of structure results in comparatively high densities. Sodium, potassium, magnesium, calcium, and aluminum with low densities are the exception.

Non-metals: Have low densities.

MALLEABILITY

Metals: Can be hammered or rolled (deformed) into sheets. A few metals, as antimony and bismuth, are brittle and will crumble.

Non-metals: Are not malleable.

DUCTILITY

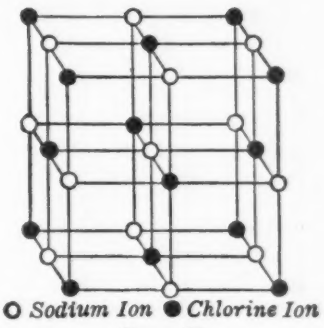
Metals: Can be drawn into a wire without breaking (rupture). Metals are usually malleable and ductile. Lead and tin are malleable but not ductile.

Group Divisions

The elements in each of the vertical groups in the periodic table (Fig. 22) are subdivided into two divisions, namely (a) and (b), because of the marked difference in properties of the elements so grouped. There is however, a striking resemblance in physical and chemical characteristics for the elements belonging to each of these subgroups, a similarity that corresponds to the grouping in the periodic table.

The elements in Group Ia, lithium, sodium, potassium, rubidium, and cesium, are called the alkali metals, because compounds of these metals, known as hydroxides, are soluble bases or alkalies. The kernel of each of these atoms corresponds to the electron configuration of the preceding inert gas element. The kernel for the sodium atom, when its single valence electron is lost, resembles the inert gas neon. This characteristic is true also for the elements classified under Groups IIa and IIIa. A common characteristic for the Group Ia elements is the single electron in the valence shell of each atom. Removal of this valence electron requires a relatively low voltage. Li. 5.36v; Na. 5.12v; K. 4.32v; Rb. 4.16v; Cs. 3.87v. Since a very high potential is required to remove a second electron from the lower quantum level of the alkali metals, chemical activity is associated with the loss or transfer of the single, loosely bound electron in the valence shell. This results in the formation of electrovalent compounds, the metal ion exhibiting an oxidation state of plus one (univalent). The crystal structure of sodium chloride (Fig. 23) indicates this bond. This electrovalent form can be demonstrated by fusing (melting) the crystal, whereupon the molten salt becomes a good conductor. Oxidation refers to the loss (transfer) of valence electrons. An oxidation state of plus one indicates one valence electron removed; an oxidation of plus two (divalent) implies the removal of two valence electrons, etc. Some physical characteristics related to the alkali metals are as follows: good conductivity, because of the loosely held outer shell electrons which can move from one atom to another in the solid state of the metal; softness and low melting points, because of the few outer binding electrons in the atom. The low temperature of a Bunsen burner flame is sufficient to excite the valence electron, imparting the characteristic colors to the flame, so that the simple spectra for these elements can be recognized.

The Group Ib metals, copper, silver and gold, bear very little resemblance to the Group Ia metals. They do not oxidize readily nor react with water; their stability has given them the name, the "noble" metals. Unlike the alkali metals they possess more than one oxidation state, with copper having a second valence number of plus two and gold plus three. The ionization potentials are greater than the values for the alkali metals. The oxides (or hydroxides) do not dissolve in water, and the basic nature of their hydroxides is not as strong as that of the alkali metals. The variable valences of these elements indicates that one or more electrons from the energy level below the valence shell can be removed by chemical means. This lower eighteen electron shell differs therefore from the eight electron inner shell found below the valence electrons for the Group Ia metals. The removal of inner shell electrons in the Ib metals serves to account for the formation of the characteristic color ions and stable complexes.



O *Sodium Ion* ● *Chlorine Ion*

Figure 23

A study of the remaining (a) and (b) Groups will emphasize the value of this periodic grouping. Group 8 in Fig. 22 represents the three groups of metals known as triads. The elements in each of these groups possess many common properties. They indicate the transition from the (a) to the (b) groups. In the transition series for each triad the electron shell is being increased from eight to eighteen electrons. They are known as transition metals. Fig. 22 represents the arrangement of the elements in the (a) and (b) groups in the periodic table.

An impressive analysis of the electroplater's metals of the future based upon the classification of the elements in the periodic table, was made by F. A. Lowenheim (Proc. A.E.S. 1948). He finds that, of the seventy metals indicated in the periodic table, only sixteen are utilized either singly or combined by the plating industry. The metals are chromium, iron, cobalt, nickel, copper, zinc, rhodium, palladium, silver, cadmium, indium, tin, iridium, platinum, gold and lead. Of the three possible roads toward development and expansion: improvement of existing processes and solutions; new and useful alloys to supplement brass, bronze, lead and tin,; new possibilities for plating materials — the author limits his study to the third approach and the reasons why many of the remaining fifty-four metals are not included in the plater's coating list.

Lowenheim uses the long form periodic table, and shows graphically the

(*Continued on page* 90)

Element	*Copper*	*Gold*	*Silver*
Atomic weight	63.57	197.2	107.88
Atomic number	29	79	47
Electrons in energy levels	2, 8, 18, 1	2, 8, 18, 32, 18, 1	2, 8, 18, 18, 1
Ionization potentials for one electron, volts	7.68	9.18	7.54

SHOP PROBLEMS

ABRASIVE METHODS SURFACE TREATMENTS CONTROL
ELECTROPLATING CLEANING PICKLING TESTING

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Rectifiers for Multi-Load Use

Question: We would very much appreciate some information on the application of rectifiers. We do only silver plating with a small amount of gold plating. We operate 7 plating tanks that require from 1-1½ volts and a current load of 60-90 amperes each, also a strike tank requiring 6 volts and approximately 100 amps., also a strip tank requiring 6 volts and 100 to 150 amperes. Our gold tank requires 2½ volts and approximately 40-50 amperes.

We have been contemplating purchasing a 1500 amp.-9 volt rectifier, but understand that there is doubt about the suitability of rectifiers in multi-load applications. We have been offered units with the voltage regulation controlled by a single manual dial or a motorized one. However, we are anxious to know whether such a set-up is practical or if the extra expense of a generator set is justified under the circumstances.

D. P. M.

Answer: Better control will be obtained if separate rectifiers are used for each tank. If one large machine is purchased, it will not only be necessary to use a rheostat on each tank but there will be a large power loss as a result of maintaining the rectifier voltage at 6 for the strip and strike tanks. Thus, each silver tank at 90 amperes will dissipate from 400-450 watts at the rheostat, depending on whether it is operated at 1 or 1½ volts. On the other hand, small rectifiers can be adjusted so that the required voltage is delivered at high efficiency to each tank.

Because the maximum load of any tank is only 10% of the rectifier capacity, the voltage regulation should not be troublesome for the 1500 ampere machine.

Refinishing Bumpers

Question: I plate automobile bumpers and, after a short time, they rust. I think that the coated surface is porous, because it has a lot of pits and they rust on the pits. The solution that I use is:

12	ounces	nickel double salts
12	"	" single salts
2	"	boric acid
2	"	nickel chloride

I want to know what is the best solution for nickel plating bumpers to do a good job, prior to chrome finish.

R. L.

Answer: Because of the corrosion pits in the bumpers, the best refinishing procedure is to apply a heavy copper plate which is then buffed in order to flow the metal over the pits. This is then followed by nickel and chromium plating, as usual.

Your present solution is suitable only for the application of thin nickel deposits. For heavier coatings, a bright nickel bath or a Watt nickel should be used, the formulas for which appear in the METAL FINISHING GUIDEBOOK.

Electroformed Stencils

Question: We make nameplates and use masks or stencils to spray paint and keep it off areas where we do not want it. Up to now we have been using a copper electrotype solution to plate the masks but we want to change over to nickel so we can use a thinner plate. Could you recommend a proper nickel plating solution for this purpose?

F. F.

Answer: Maximum speed can be obtained from the fluoborate or sulfamate nickel solutions, without the necessity for raising the temperature to the point where it might affect the stripping of the electroform from the matrix. If speed is not a factor, an electrotype nickel solution might be suitable.

The fluoborate and sulfamate processes are sold in solution form but data on other nickel baths will be found in the METAL FINISHING GUIDEBOOK.

Etching Stainless Steel

Question: We are encountering difficulty in obtaining a smooth, uniform, deep etch in the background etching of Type 301 stainless steel nameplates. A ferric chloride and water solution, operated at 40° Baume and room temperature, is being used with air agitation of the solution and agitation of the work.

Any information on etching solutions and procedures for stainless steel would be appreciated.

L. E. C.

Answer: Better results will be obtained with an etch made up of equal volumes of the 40 deg. Bé ferric chloride and muriatic acid. This solution can be used with reverse current, if desired. Additions of a wetting agent and hydrofluoric acid in small amounts may also be helpful.

Alternating Current Ripple

Question: Please inform me of the influence of rectified AC ripple on electrodeposits, specifically cadmium.

K. A. C.

Answer: Ripple ordinarily has no noticeable effect, except in the case of bright nickel and chromium plating. For these solutions, full-wave, three phase rectifiers are usually recommended, since the ripple is less than 5%.

Preece Test for Zinc

Question: The Navy and Underwriters have specifications for a copper sulphate solution for measuring the thickness of bright zinc plating. Can you tell me the time and the thickness of this solution, also the mixture of it?

C. W.

Answer: The Preece test was formerly used for determining the thickness of zinc coatings. The solution consists of 36 parts by weight of copper sulfate crystals in 100 parts by weight of water. Excess cupric oxide is added to neutralize any excess acid and the solution filtered before using. Articles are cleaned with solvent, then dipped in the solution for exactly 1 minute at 65 deg. F., washed and wiped dry. The copper smut is removed with a bristle brush and the one-minute dips repeated until an adherent copper deposit forms. Each dip is equivalent to about 0.0003" of zinc.

This test method is not only quite inaccurate but is unsuitable for thin electrodeposits and has been superseded by the dropping tests, details of which will be found in the METAL FINISHING GUIDEBOOK, page 480. Other methods which are acceptable to government agencies will also be found in this section.

Hydrometer for Silver Solution Control

Question: Your Dictionary of Metal Finishing Chemicals does not have the information I'm looking for. Could silver chloride solutions be controlled by Baume? The formula is:

Sodium cyanide	8 oz./gal.
Silver chloride	3 "

A. M.

Answer: Cyanide plating solutions cannot be controlled by Baume readings, since accumulation of carbonates results in higher readings as the solution ages.

Lacquer Adhesion on Bright Dipped Brass

Question: We are using a bright dip (sulphuric acid ½ pint/gal., sodium dichromate 4 oz./gal.) for some of our brass sheet products, which we find quite satisfactory. However, some of these products require a lacquer or enamel finish on some areas, which we apply through suitable masks. We find very poor adhesion and peeling of the paint film. We think our rinsing is adequate. Can you suggest any reason for the peeling and a possible "passivating" dip as a remedy?

S. J. S.

Answer: There should be no trouble experienced in lacquering over parts which have been dipped in the sulfuric-dichromate solution since, if anything, the chromate film will improve adhesion.

The obvious possibility to explain the lack of adhesion is the presence of moisture on the surface of the brass

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due to insufficient drying. We would suggest that you investigate this factor.

Lining for Nitric-Hydrofluoric Dip

Question: We are presently using Koroseal lined steel tanks for a 9:1 (nitric acid: hydrofluoric acid) mixed acid dip at room temperature and it has been fairly satisfactory. Are there materials available which may be more adequate for this purpose? Without assurance that a satisfactory adhesive is available, we would not consider carbon brick.

E. M.

Answer: Polyvinyl chloride formulations of various types have been used successfully for mixture of hydrofluoric and nitric acids at temperatures below about 150 deg. F. Koroseal is a member of this group. Tygon. which is also a polyvinyl resin, will also be suitable.

Satisfactory adhesives and mortars are available for carbon brick. A description of this type construction will be found in an article by Jaray in the March 1955 issue of METAL FINISHING.

Pickling Gold-Filled Parts

Question: We are having difficulties in taking fire out of gold filled work. I would like to know another possible way besides the mild pickle dip we are now using. It seems to remove some of the gold. Have you any special way for removing the fire or scale without removing any of the gold?

A. L.

Answer: The mild sulfuric acid pickle is the standard method for removing scale from gold-filled articles. This dip does not have any measurable attack on gold and we would suggest that you investigate other possible causes for removal of the gold, unless your present dip is other than sulfuric acid.

Scale Removal and Embrittlement

Question: I hope you can give me the answers to the following questions:

1. Do all acids cause hydrogen embrittlement
2. Does plating cause hydrogen embrittlement
3. How long, at room temperature, does it take to relieve embrittlement
4. How can I best remove welding oxide from silver-soldered type 303 stainless steel?

A. J.

Answer: All acids do not cause embrittlement. However, the acids which are employed to remove scale from steel, namely sulfuric, hydrochloric and phosphoric acids will cause embrittlement to some extent.

Embrittlement during plating is the result of hydrogen evolution. Those solutions which have a cathode efficiency of 100% do not evolve hydrogen and, as a result, do not cause any appreciable embrittlement.

Room temperature storage is not satisfactory for relieving embrittlement. Baking at elevated temperature will help.

Removing welding oxide from silver-soldered stainless steel is best effected by abrasive blasting. If this is not feasible, warm 10% sulfuric acid should be used.

SCIENCE FOR ELECTROPLATERS

(Continued from page 87)

current picture in the electroplating industry, as follows (Fig. 24):

Black squares — metals now in commercial use in electroplating.

Shaded squares — elements having no practical possibilities, either nonmetallic or chemically overactive, e.g., the alkali or alkaline earth metals.

Small black squares — metals which can be deposited but which are not in commercial use.

No symbol — metals which have been investigated very little or unsuccessfully.

In considering the possibilities of the last two types, emphasis was placed upon examples of metals used currently that, in the not so very distant past, were laboratory curiosities or were considered impractical for commercial application. Cadmium, for example, has only been plated commercially for the past forty years; chromium was not available commercially thirty years ago; rhenium has been in use twenty years, rhodium about fifteen years, and indium as recently as ten years. This is a useful reminder that current technological development in plating processes is so rapid that metals fairly uncommon today may, in the near future, be added to the list of materials available for the plater. Intensified competition will serve to accelerate the research efforts of the laboratories, a program that is becoming an essential part of the modern electroplating industry. It is of interest to note that the element of cost is not necessarily a deterrent to development. Two examples may be cited to support this view; rhodium, at $2,000 per pound, and gold, at $500 per pound, are used by the plater in specific applications. Cost can often be reduced, as has been the case with the pricing of indium in the last few years.

The evaluation of the remaining metals in the periodic table for possible use in the plating field is made on the basis of their grouping in the periodic table. Metals discussed are those belonging in Groups IIIb to VIIb and the metals in Group Va. This comprehensive analysis by the author is based upon a thorough study of the literature available for the various metals.

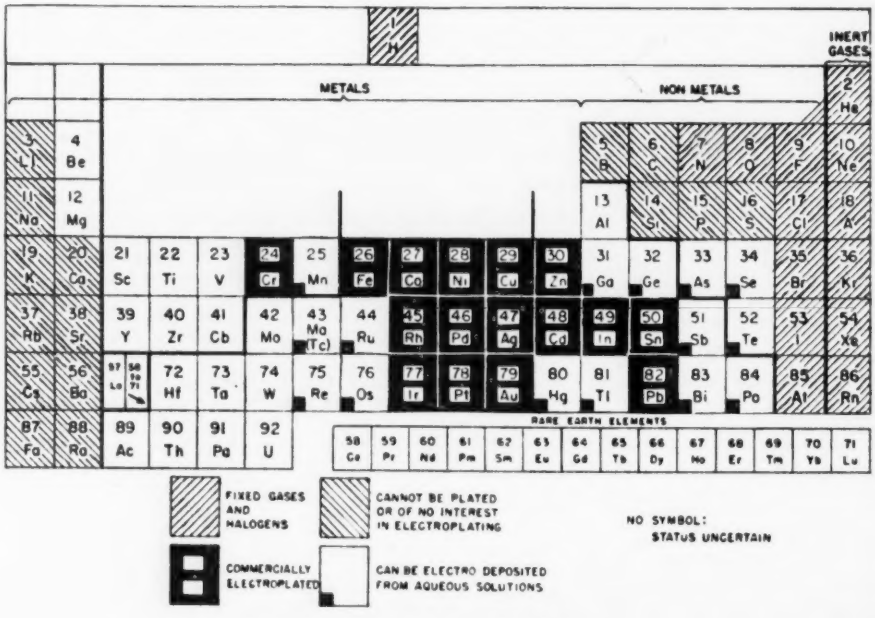

Figure 24. Periodic chart of the elements.

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If you're already set up for Liquid spray buffing, we'll be glad to send you working samples of Lea Liquabrade. Just tell us what your finishing operations are and what metals are being buffed. Our laboratory will evaluate this data and recommend the proper Liquabrade buffing compounds for your use.

If you're using bar buffing compounds, write us in detail and we'll be glad to outline the savings to be made by shifting over to the Liquabrade Method of Spray Buffing.

Our objective is to help you save money on your metal finishing operations.

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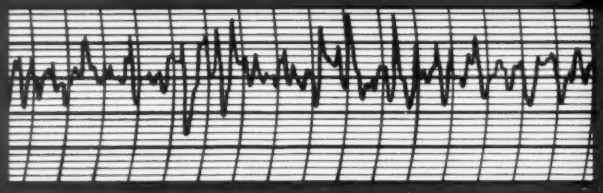

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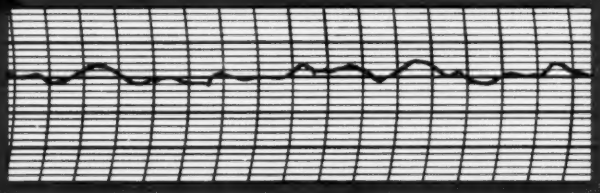

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***patents pending.**

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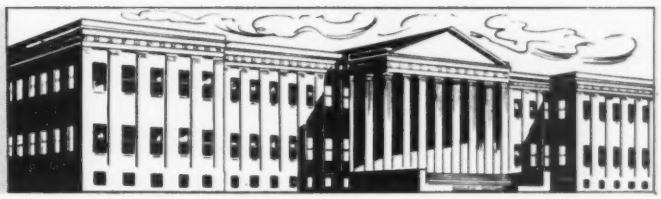
Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD



Silver Tarnish Prevention

U. S. Patent 2,701,238. *Feb.* 1, 1955. *A. Renold, assignor to Bates Manufacturing Co.*

A textile-treating composition for producing silver protecting textile material, comprising a water-insoluble silver compound reactive with hydrogen sulfide and a solid filler-grinding aid selected from the group consisting of natural starches and modified and incompletely hydrolyzed starches in the proportion of at least one-half part filler-grinding aid per part of silver compound but less than will render the silver compound unavailable for reaction with hydrogen sulfide after deposition on a textile, the silver compound and filler-grinding aid being ground and dispersed together in finely-divided form in a drying oil in the proportion of at least one-half part drying oil per part of silver compound, said composition being free from water-soluble salts.

Metal Spraying

U. S. Patent 2,701,775. *Feb.* 8, 1955. *J. B. Brennan.*

The method of spray depositing metal which includes the steps of fusing metal, conducting the fused metal under pressure substantially in excess of atmospheric pressure to a spray nozzle, forcibly discharging the fused metal issuing therefrom from the spray nozzle, the metal being atomized solely by the pressure of the metal itself and by directing portions of the molten metal in converging directions to cause the particles of the molten metal to collide and divide into particles of very fine size, directing the metallic spray so produced into a chamber containing a reducing atmosphere, cleaning a surface to be metallized by subjecting the surface to the action of a reducing flame, thereafter placing said surface within said chamber and directing the spray against said surface, the particles composing the spray impinging on the surface while in a molten or plastic state.

Gas Plating

U. S. Patent 2,701,901. *Feb.* 15, 1955. *P. Pawlyk, assignor to The Commonwealth Engineering Co. of Ohio.*

A method of producing nickel metal foil by thermal decomposition of nickel carbonyl which comprises the steps of providing a closed gaseous metal plating chamber, continuously moving an endless metal belt through said chamber, oxidizing the surface of said endless metal belt by subjecting the same to a heated oxidizing atmosphere, removing oxygen from the plating chamber by passing inert gas therethrough, thereafter contacting said moving oxidized belt surface with heat-decomposable gaseous nickel carbonyl, raising the temperature of said endless moving metal belt to between about 300 to 400°F. and circulating said heat-decomposable gaseous nickel carbonyl in contact therewith to cause the gaseous metal compound to decompose and deposit nickel metal onto the oxidized metal belt surface as a thin metal film, and stripping the thus deposited nickel metal film from the oxidized metal belt as a continuous sheet of nickel metal foil.

Blade Polishing Machine

U. S. Patent 2,701,937. *Feb.* 15, 1955. *E. E. Murray.*

In a blade polishing machine, a base, a carriage slidably mounted on said base for reciprocatory motion thereon, a pair of oppositely disposed backing members mounted on said carriage, each of said backing members comprising an outer portion having the face thereof shaped substantially complementary to one side of the blade to be polished and being formed of a rubber of one hardness impregnated with a bonded abrasive mineral and an inner portion backing said first portion and integral therewith and formed of a rubber of a softer degree of hardness.

Rhodium Plating

U. S. Patent 2,702,252. *Feb.* 15, 1955. *L. A. Suchoff, assignor to the United States of America.*

A method of coating the copper diagram of a printed circuit with rhodium comprising dipping the printed circuit into a bath containing a rhodium salt, allowing the rhodium to be precipitated on the copper surface and removing the printed circuit from the bath before the rhodium film starts to become spongy.

Metallizing Non-Conductors

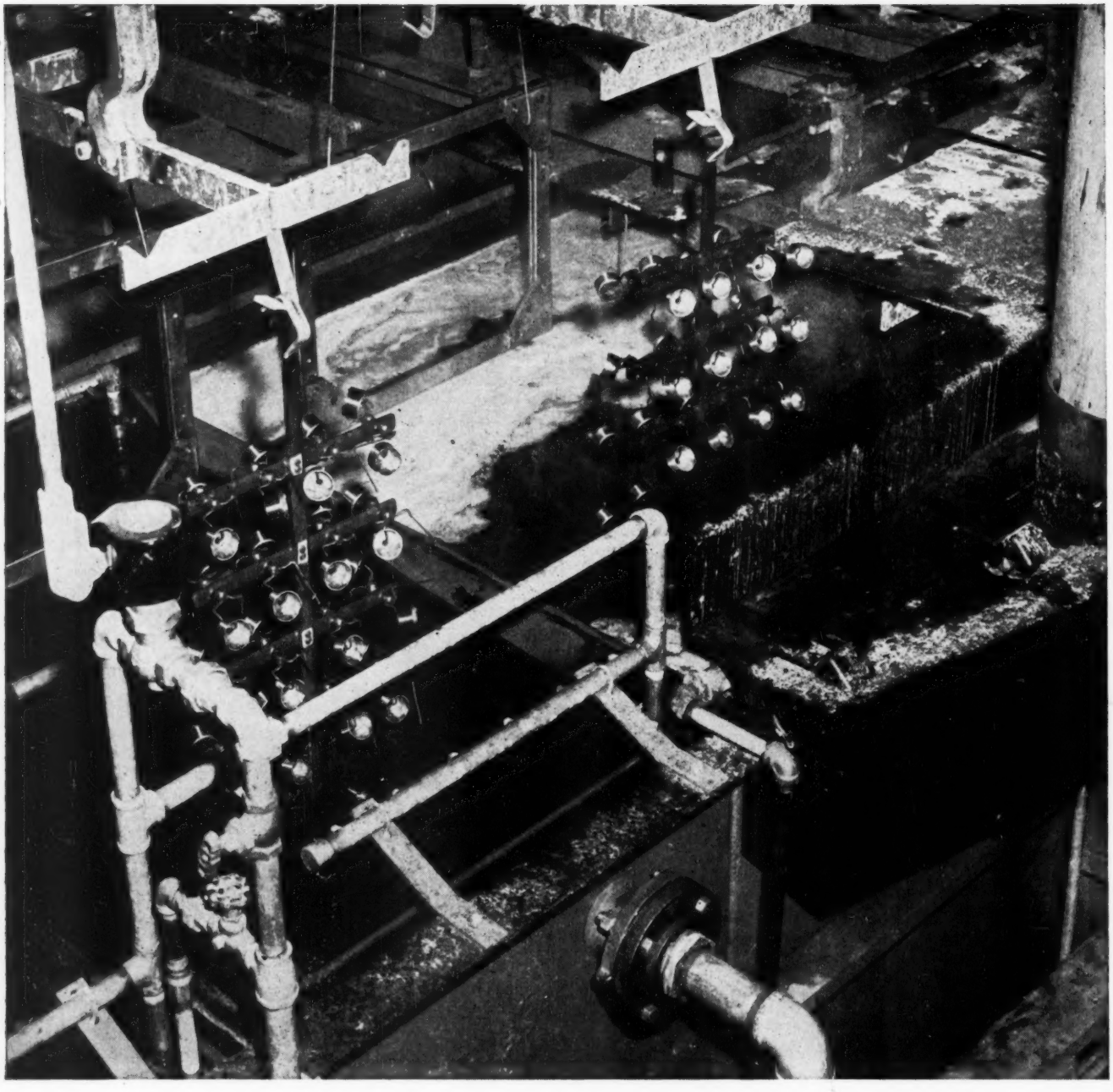
U. S. Patent 2,702,253. *Feb.* 15, 1955. *E. A. Bergstrom, assignor to Svenska Aktiebolaget Gasaccumulator.*

A method of metallizing a surface which does not reduce stannous chloride with at least one desired coating metal selected from the group consisting of Os, Ir, Pt, Rh, Ru, Pd, Fe, Co, Ni, Cr, Al, Mg, and Mn, comprising the steps, first, of steeping said surface in a dilute solution of $SnCl_2$ and then rinsing the same, second, of steeping the same in a dilute solution of a chloride of palladium, and third, of steeping the same in a solution containing a salt of said desired metal.

Electroforming Screens

U. S. Patent 2,702,270. *Feb.* 15, 1955. *D. J. Donohue and A. M. Rennie, assignors to Radio Corp. of America.*

A method of making a fine mesh metallic screen which comprises in combination the steps of applying to a ceramic master plate ruled with a network of grooves a solution of wax suspended in a volatile solvent, evaporating said solvent and thereby forming a thin film of wax on the surface of said plate the thickness of said wax layer being less than the depth of said grooves, sputtering onto the surface of said wax a film of at least one metal



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selected from the group consisting of gold, platinum and palladium in a vacuum by an electrical discharge from a solid electrode of said metal, removing substantially all of said wax and sputtered metal only from the elevated areas of said plate, electrodepositing additional metal over the sputtered metal remaining in said grooves, and separating the formed screen from said master plate.

Bright Gold Bath

U. S. Patent 2,702,271. *Feb.* 15, 1955. *V. Spreter and J. Mermillod.*

A process for the electrolytic deposition of a member selected from the group consisting of gold and gold-copper alloys predominantly of gold which comprises passing an electrolytic current through an equeous solution containing an alkaline cyanide and a cyanide of said selected member, and containing, in solution in the bath, a small quantity of a nitro compound selected from the group consisting of nitro-guanidine and nitro-urea.

Hot Dipping Aluminum

U. S. Patent 2,702,525. *Feb.* 22, 1955. *M. G. Whitfield, assignor to Whitfield & Sheshunoff, Inc.*

Apparatus for use in the production of an even coating of aluminum on wire or strip, which comprises a pot for holding molten metal, means for passing said wire or strip into a bath of molten metal in said pot and out at the surface of said molten metal at a point separated from the surrounding walls of said pot, induction heating means for the molten metal in said pot, said induction heating means being located externally of said pot and having channels leading into said pot through the walls thereof at points adjacent to the bottom of said pot, one at least of said channels serving as exit means for molten metal from said pot and another at least of said channels serving as entrance means for molten metal into said pot, said induction heating means serving to propel the molten metal through said channels and heat it while being propelled, and a hollow fitting of tubular form connected with said entrance channel beneath the surface of said bath and extending to the surface of said molten metal at the said exit point for said strip or wire, and serving to isolate the entering molten metal from said bath substantially to said exit point whereby to deliver to said exit point the incoming molten metal in a stream of substantially undiminished force and whereby said wire or strip is caused to exit from said bath in said stream.

Porcelain Enameling

U. S. Patent 2,702,762. *Feb.* 22, 1955. *A. E. Chester, assignor to Poor & Co.*

In a method of coating ferrous metals with vitreous enamels, the step which comprises pretreating the ferrous metal with a substantially uniform thin coating containing potassium antimonyl tartrate and a chloride of a metal from the group consisting of barium, strontium, manganese and magnesium.

Phosphate Conversion Coating

U. S. Patent 2,702,768. *Feb.* 22, 1955. *M. Hyams and A. Nicholson, assignors to Parker Rust-Proof Co.*

A liquid composition for the production of phosphate coatings on ferrous surfaces, said composition consisting of an aqueous solution consisting essentially of at least one substance selected from the group consisting of phosphoric acid, ammonium phosphate and the alkali metal phosphates, said phosphate being present in a concentration of from 0.05 to 0.25 molar, hydroxylamine in the amount of .1 per cent to .5 per cent and the salts thereof in an equivalent concentration, said solution containing sufficient alkaline material to produce a pH within the range of 4.2 to 5.8.

Hard Chromium

U. S. Patent 2,702,785. *Feb.* 22, 1955. *P. Eyerund, assignor to Metallgesellschaft Aktiengesellschaft.*

A method of applying a strongly adherent hard chromium plating upon an article having a surface of a light metal selected from the group consisting of aluminum, aluminum base alloys, magnesium and magnesium base alloys which comprises pickling the light metal surface to remove oxides, plating the thus cleaned surface with a thin metal layer of a metal selected from the group consisting of brass, nickel, iron and copper, immersing the plated metal surface into a chromium plating bath, substantially completely dissolving said metal layer from said light metal surface while

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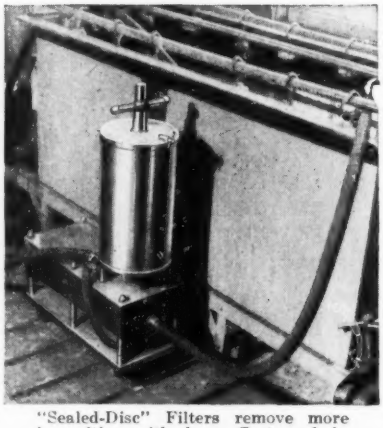

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immersed in said chromium plating bath and then immediately electroplating the surface with hard chromium while still in said chromium plating bath.

Method of Lining a Tank

U. S. Patent 2,703,299. *Mar.* 1, 1955. *R. B. Seymour and R. H. Steiner, assignors to The Atlas Mineral Products Co.*

The method of lining a tank with polyvinyl chloride resin sheets which comprises skiving the vertical edges of the sheets, securing the sheets to the tank with the skived edges forming a V opening facing the inside of the tank, filling said V opening with a plastigel, and applying heat to the plastigel and surrounding polyvinyl chloride resin.

Cadmium Fluoborate Bath

U. S. Patent 2,703,311. *Mar.* 1, 1955. *R. E. Alexander, assignor to North American Aviation, Inc.*

An electroplating bath comprising an aqueous solution of cadmium fluoborate containing from 0.2 to 5.0 grams per liter of an enzyme selected from the group consisting of pepsin, diastase of malt and rennet.

Brush and Brush Material

U. S. Patent 2,703,472. *Mar.* 8. 1955. *R. O. Peterson, assignor to The Osborn Mfg. Co.*

A polishing brush of the character stated, comprising a hub body, flexible fiber strands of absorbent material secured at their ends in the peripheral surface of the body to extend radially therefrom, and particles of abrasive material absorptively retained in the fiber strands.

Immersion Copper

U. S. Patent 2,703,295. *Mar.* 1, 1955. *M. S. Kantrowitz and A. E. Yelmgren.*

A copper plating composition comprising an aqueous solution containing about 2 to 5 per cent of ammonium hydroxide, about 5 to 10 per cent of neutralized copper sulfate, and about 4 to 6 per cent of pyrogallol.

Vacuum Metallizing

U. S. Patent 2,703,334. *Mar.* 1, 1955. *P. J. Clough and P. Godley 2nd, assignors to National Research Corp.*

A wick element for evaporating aluminum in a vapor deposition device, said wick element being wettable by molten aluminum, being relatively inert to molten aluminum and comprising an elongated rod whose surface layer consists essentially of a carbide of a metal taken from the class consisting of titanium, zirconium, hafnium, vanadium, columbium, and tantalum, the interior of said rod consisting of elemental carbon and having a relatively higher electrical resistance than the surface of the rod, said rod being essentially free of all volatiles having a vapor pressure greater than about 1 micron Hg abs. at a temperature above about 1400°C. in order to provide an essentially gas-free rod, the surface of said rod being essentially free of gas-producing oxides of said carbide-forming metals.

Coating Thickness Tester

U. S. Patent 2,703,384. *Mar.* 1, 1955. *G. H. Rendel, assignor to United States Steel Corp.*

Apparatus for measuring the thickness of a non-magnetic coating applied to a moving strip of magnetic material, which apparatus comprises a roll at the entry end of the coating apparatus over which the strip passes, a first magnetic head adjacent said roll adapted to contact the uncoated strip on the side opposite said roll, a roll at the exit end of the coating apparatus over which the coated strip passes, a second magnetic head adjacent said second roll adapted to contact the

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coated strip on the side opposite said second roll, each of said magnetic heads including a coil, said coils being connected in a bridge circuit with the first and second coils being connected to each other, a third coil in said bridge circuit, a fourth coil in said bridge circuit, said third and fourth coils being connected to each other and to said first and second coils respectively, a pair of lead wires one connected to the bridge circuit between the first and second coils and the other connected to the bridge circuit between the third and fourth coils, said lead wires being adapted to be connected to an A.C. power source, a second pair of wires one connected between the first and third coils and the other connected between the second and fourth coils, and means for measuring the potential between the second pair of wires.

Apparatus for Descaling and Coating Wire

U. S. Patent 2,703,550. *Mar.* 8, 1955. *G. W. Bell, assignor to Northwestern Steel & Wire Co.*

A descaling assembly comprising a rotary drum, means dividing said drum into a plurality of chambers including a tumbling chamber, a lime applicator chamber, and a lubricant applicator chamber, means for passing an article to be descaled successively through said tumbling chamber, said lime applicator chamber, and said lubricant applying chamber, a plurality of hard metallic balls in said tumbling chamber for abrading said article upon rotation of said drum, and agitator elements in said lubricant applying chamber for agitating lubricant disposed in said chamber.

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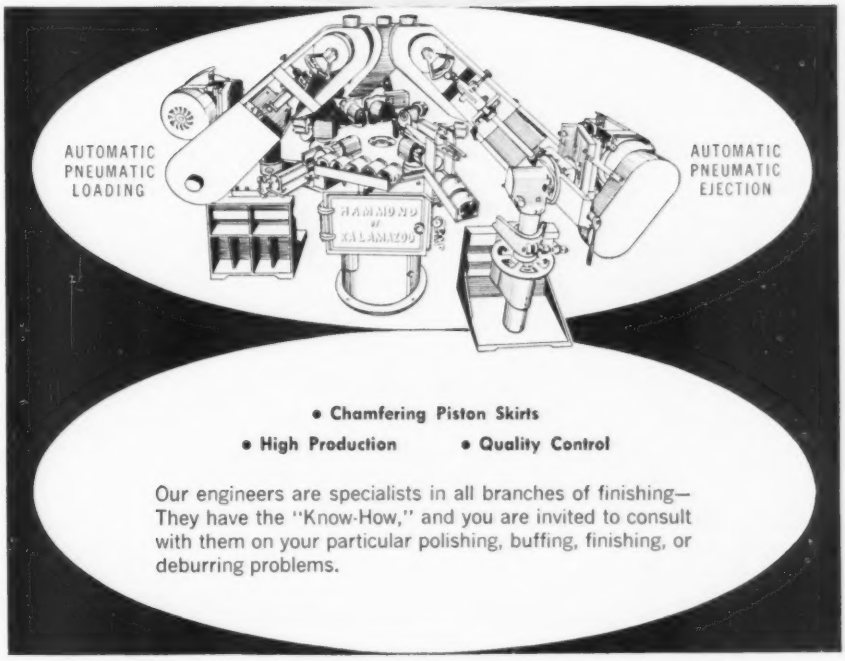

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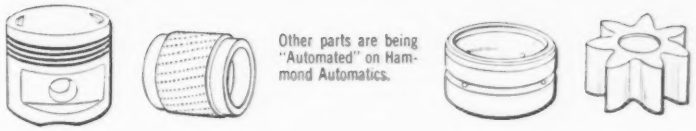

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ABSTRACTS

Electropolishing of Stainless Steel Knifeblades In Perchloric Acid Bath

H. Stuedemann and W. Then: *Forschungsbericht.* No. 65 (1954), Reseach Institute of Metal Technology, Solingen, Germany.

Two functions have to be achieved with a successful commercial electropolishing process; first is the removal of the surface roughness peaks and projections which contribute to a rough surface and, secondly, the filling in or smoothing away of the depressions in the general surface unevenness or, in other words, the production of a really plane, smooth and level surface. This second effect is the one which contributes to the production of surface brilliance or finish and is the one which is most difficult to achieve with electropolishing. The surface roughness peaks are relatively quickly removed by the electropolishing action and a much smoother surface is soon obtained; the planing out of the surface depressions however, is a much slower process. Where the surface is deeply fissured or scratched, therefore, and the electropolishing process is prolonged so as to remove these, the net result is not a plane surface but a wavy-type surface.

In addition to the microscopic effect of the levelling down of the surface roughness, the polishing action which is microscopic in its nature is presumably influenced to a considerable extent by the thickness and composition of the polishing film which is formed at the anode. The polishing film apparently causes the perfect statistical solution of the individual metal atoms from the crystal lattice so that no etch structure is formed and the polish effect is, accordingly, not impaired. The mechanical polishing

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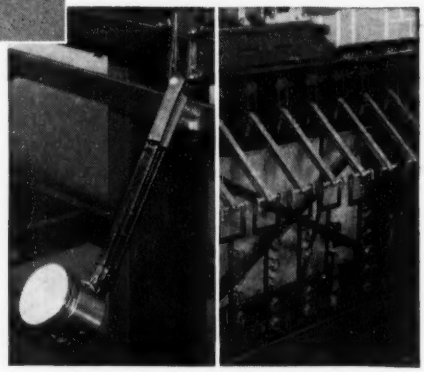

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by D. J. Swaninger
Sales Manager—Stevens Compositions

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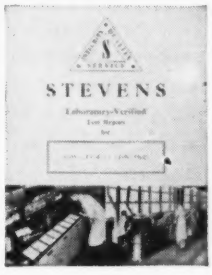

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effect can only be achieved with electropolishing under special conditions. Also the structure of the metal core right up to the surface remains undisturbed with electropolishing and any defects in the steel are made immediately visible.

The perchloric acid-acetic acid polishing baths, which were found by test to give the best results with stainless steel knife blades are given below. These baths were found best for the metal, which was a stainless steel with a more or less low carbide, martensitic structure. The mixtures found suitable contained:

Perchloric acid (1.61)	185-205 cc.
Acetic acid	765 cc.
Water	30- 50 cc.

The bath was operated at 10-30 volts, with current densities of 1.3-2.5 amp./sq.dm. and bath temperature of 16-20°C. The knife blades were well polished but the brilliance and smoothness of mechanically polished blades was not attained. Because of the relatively low current densities used, in spite of the high current efficiency (about 100%) relatively long polishing times were required (about 20 minutes).

Comparison of Results with Chemical and Electrolytic Polishing of Aluminum

By A. Fischer and L. Koch; (Research Communication from Siemens and Halske A. G. Germany, Laboratories); A.D.A. Tech. Mem. No. 219, 1954.

Chemical polishing proceeds easier with the less noble metals, whose solution velocities are relatively high. This renders aluminum particularly suitable for chemical polishing; however, zinc, magnesium, cadmium and other non-noble metals, under certain conditions, can also be chemically polished. The already high solution speed of these metals must be increased by additional measures so that the polishing effect occurs. Expressed in terms of electrochemistry, this signifies an increase of the cell voltage with the individual local cells. The technical processes covering chemical polishing solve these requirements by three measures:

1. Usually the temperature is increased, which obviously serves to increase the attack.

2. The polishing solution contains oxidizing substances with a nobler redox potential as depolarizers, for example, nitrates or nitrites.

3. Finally, there is added the salt of non-noble heavy metal, for example copper in small amounts.

In this way the effect is achieved that the nobler heavy metal is deposited on the surface of the metal to be polished, for example aluminum. The one local electrode of the local cell then consists of finely divided copper.

If these three measures are combined with one another then the metal does, in fact, dissolve particularly rapidly, even vigorously. On the aluminum surface there are thus concerned local cells of the following composition: (-) Al/acid (or alkali) Redox system/nobler metal (+).

As the acid, there is used mostly concentrated sulfuric, phosphoric, or hydrofluoric acids; as the Redox system, NO_3 /N red; as (catalyzing) conducting electrode (local cathode), copper, deposited in a spongy form. In the Redox system, N red signifies the various reduction products of the NO_3 ions. In place of NO_3, NO_2 is also used.

The authors investigated the processes: Alupol (alkaline), Alupol (acid), EW process, VAW process. The different surface conditions were evaluated and the metal removal ascertained.

Aluminum Polishing Processes

Metallwarenindustrie und Galvanotechnik. Vol. 45, No. 10, p. 501.

DRL Process: This is an electrolytic process for the brightening of 98% aluminum alloys. The process has been developed for the treatment of 25 alloy reflectors. The operating data are as follows:

Phosphoric acid (1.58)	90 vol.%
Butyl alcohol	10 "

The bath temperature is 60°C. and current density is 10-20 amp./sq. dm. The treatment time is 5-15 minutes and movement of the parts in the longitudinal direction of the cathode is recommended. Glass containers or, for large installations, lead-lined baths are used for the treatment. For anodizing after brightening, the anodizing time should not exceed 10-15 minutes, and anodizing is conducted in a sulfuric acid electrolyte.

VAW Process: This is an electrolytic brightening process for Raffinal

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metal. The pickling is conducted in 10% caustic soda at 50-60°C. for about 1 minute. The polishing bath has the following characteristics:

Sodium sulfate 10%
Sodium hydroxide 1%

The bath voltage is 8-10 and current densities of 10-15 amp./sq. dm. are used. The bath temperature is 90°C. The current pulse with this process must be damped out. After thorough rinsing, the electrolytic polished parts are dipped in a weak acid, again well rinsed with water and subsequently anodized in a sulfuric acid electrolyte.

Bath Control Conditions with Tin-Nickel Alloy Plating

By B. Keysselitz: *Metallwarenindustrie und Galvanotechnik.* Vol. 45, No. 10, pp. 486-487.

No serious difficulties are encountered with tin-nickel plating and the bath control is simple. In order to obtain good deposits, the composition of the bath and particularly the concentration of the stanno-salt and fluoride and the current density and temperature must be maintained within the limits specified. The absence of solid particles is of outstanding importance but it is just as important that the electrolyte should be free from dissolved impurities, as a whole series of these even in relatively small amounts can adversely affect the coating. The possible dissolved impurities are metals which inadvertently come into the bath. The electrolyte attacks all normal metals and alloys with the exception of nickel. Steel or brass parts dissolve immediately if they only hang for a short time in the electrolyte without current.

If the bath is operated normally, then just as much metal is dissolved from the anodes as is deposited at the cathode so that the concentration of tin and nickel in the electrolyte does not change. On the other hand, the stannous content in the bath slowly drops. A certain loss of both metals and of fluoride occurs as a result of drag-out but this can be reduced if the parts are first placed in a preliminary rinse tank which is used for bath make-up. The liquid in the pre-rinse tank should have a pH of 2.5. A certain amount of fluoride is lost at the bath temperature of 65-70°C. and this must be replaced. The appearance and particularly the brilliance of the coating depends, to a considerable extent, on the fluoride content of the bath. The fluorine loss is caused (a) by precipitation of the compound Na_2SnF_6 and (b) by the drag-out loss with the ware. The former is more important since the drag-out loss can be compensated for.

The production of deposits of the correct composition and the best possible brilliance depends principally on maintaining the stannous concentration within the limits given below and seeing that sufficient fluoride is available to link 4 fluorine atoms to each stannous atom and 6 fluorine atoms to each stannic atom in the electrolyte. This rule is of fundamental importance. Practically all the tin is present in the stannous form in a new bath. The electrolyte then ages and some tin is slowly oxidized to stannic ion. For satisfactory working of the bath, the minimum amounts of total fluorine which must be present can be calculated as shown below.

Slow oxidation occurs in the bath when in use and it is necessary in practice, as a safety precaution, to set the total fluorine content somewhat above the minimum content. A safe excess of fluorine is present if the fluorine concentration is made equal to the sum of the concentrations of stannous and stannic ion. This would signify that the factor in the above equation is raised to the value of 1.

$$\text{Minimum Fluorine requirement in g./l.} = 4a \left[\begin{matrix}\text{stannous ion} \\ \text{g./l.}\end{matrix}\right] + 6a \left[\begin{matrix}\text{stannous ion} \\ \text{g./l.}\end{matrix}\right]$$

$$\text{in which } a = \frac{\text{atomic weight of fluorine}}{\text{atomic weight of tin}} = \frac{19}{118} = \text{about } \frac{1}{6}$$

$$\text{Minimum fluorine requirement g./l.} = \frac{2}{3} \times \left[\begin{matrix}\text{stannic ion} \\ \text{g./l.}\end{matrix}\right] + 1 \times \left[\begin{matrix}\text{stannic ion} \\ \text{g./l.}\end{matrix}\right]$$

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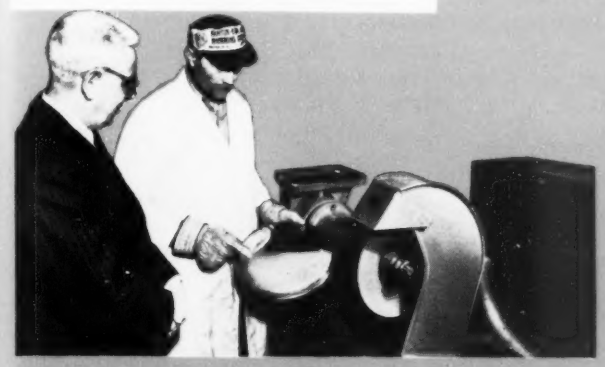

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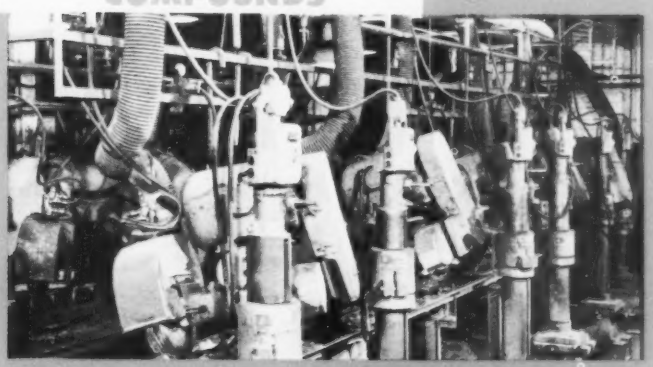

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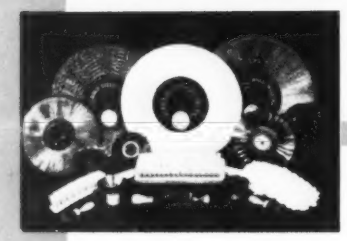
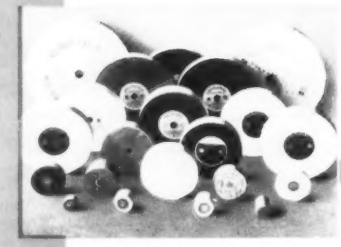
This program of *proving* performance in *all* finishing operations is your guarantee of superior finishes that will clean and plate well. Whether standard products or custom-designed items such as special compound shapes, *all* H-VW-M mechanical finishing products are backed up by this *integrated* laboratory policy . . . every H-VW-M quality-assuring facility combined to bring you only the best.

...ed ve, *ask for the literature described in this bulletin.*



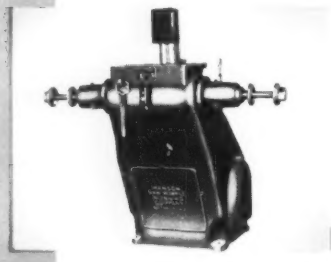
BRUSHES

. . . for every need in metal cleaning and polishing. H-VW-M StapLbond Tampico and Wire Brushes, Circular Wire Scratch Brushes, Circular Tampico and Nylon Brushes, Satin Finish Hanger and Goblet Brushes, and a wide selection of platers' specialty brushes. *For full details, ask for Bulletin BR-106.* NEW—H-VW-M Helical Brush Units for continuous strip cleaning of metal. *Ask for Bulletin HB-100.*



POLISHING WHEELS

. . . a proper type for every application. H-VW-M Invincible, Universal, Victory, Rival and Triplex Cloth Wheels; Monarch, Empire, Union, United and Quilted Canvas Wheels; Cemented, Quilted and Loose Sheepskin Wheels; Felt Wheels and Leather-Covered Wood Wheels—each type with specific advantages. Also a full line of wheel accessories such as Aloxite, TP Abrasive, Turkish Emery, Klinch Grain Cement and Thinner, Belgrade Glue, Modern Wheel Trimmers. *For full details, ask for Bulletin W-103.*



POLISHING AND BUFFING LATHES

. . . a wide variety for every production plant or job shop need: Model MS for general work, MI for smooth operation with utmost convenience, MSV with continuously variable speed, DMI for continuous production with independent spindles, VST and VCST with two motors and spindles—plus VCSTV with continuously variable speed, VJ for light work, VH for heavy duty and VH-X for extra-heavy duty with semi-automatics, DB-3 Backstand with spring tension, DBA "Tensionaire" Backstand with automatic air tension control, VCL low-type and VR bench-type—plus VRV bench-type with continuously variable speed—for operation while sitting. *For full details, ask for Bulletin L-204.*

EQUIPMENT AND ACCESSORIES

. . . *everything* else that's essential to top-quality mechanical finishing: Pumice, Eclipse Steel Balls, Burnishing Barrels, Tumbling Barrels, Felt, and a host of similar products—all designed to work *together* for the finest possible finish.

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Barrels, Plating
Basket, Scrap Anode
Baskets, Dipping
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Buffs
Cathode Rockers
Chemicals, Plating
Chrome Spray Floats
Cleaners and Solvents
Compounds
Conveyors, Full Automatic
Conveyors, Semi-Automatic
Cooling Coils
Crocks, Earthenware
Degreasing Solvents
Dryers
Exhaust Fans
Filters
Felt
Fluxes
Generators
Gloves, Platers'
Glue, Belgrade
Heaters
Heating Coils
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1313

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Recent Developments

NEW METHODS, MATERIALS AND EQUIPMENT
FOR THE METAL FINISHING INDUSTRIES

Round Lead Anodes

Heil Process Equip. Corp., Dept. MF, 12901 Elmwood Ave., Cleveland 11, O.

New round lead anodes for chromium plating are supplied in four standard sizes — Standard, Medium, Heavy, and Super R. The availability for the first time of four sizes allows the use of the best diameter size for each specific chromium plating requirement.

Six styles of knife edge hooks and two heavy duty flat face hooks are available. Flat bent copper hooks can also be furnished to exact specifications. This wide range of standard lead coated copper alloy hooks provides a hook to exactly fit all bus bar and solution level requirements. For additional hook protection, a vinyl plastic hook coating is furnished as an optional feature.

The anodes are supplied of virgin lead and tin materials specially alloyed for use in all chromium solutions. Other alloys can be furnished. The round anode design assures better current distribution, affording faster plating and better chromium coverage.

Treated Sisal Buffs

American Buff Co., Dept. MF, 2414 S. LaSalle St., Chicago, Ill.

A new treatment for sisal buffs is claimed to eliminate fraying and to increase buffing compound absorbency.

The result of four years of research and experiment, this unique, new treatment adds a special adhesive substance to buffs which holds the sisal fibers closely together, yet does not materially change the buff's density to either excessive softness or hardness. In addition, the treatment also overcomes the difficulty of holding buffing compound on sisal fibers. As a result, buffs treated by the new process are stated to give improved buffing action, longer wear and faster cutting speed.

Stripper for Anodized Aluminum

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

Deoxidizing Compound 89 is a non-chromic acid containing material for stripping all types of anodic coatings from aluminum parts and racks. The stripper is alkaline in nature and is used in water solution at room temperature for removing these anodic coatings by immersion only. Average coatings are removed in a few seconds. The compound contains no ingredients which make waste disposal a problem. Literature is available.

Automatic Plater

Platocrat Div., Wagner Bros., Inc., Dept. MF, 418 Midland Ave., Detroit 3, Mich.

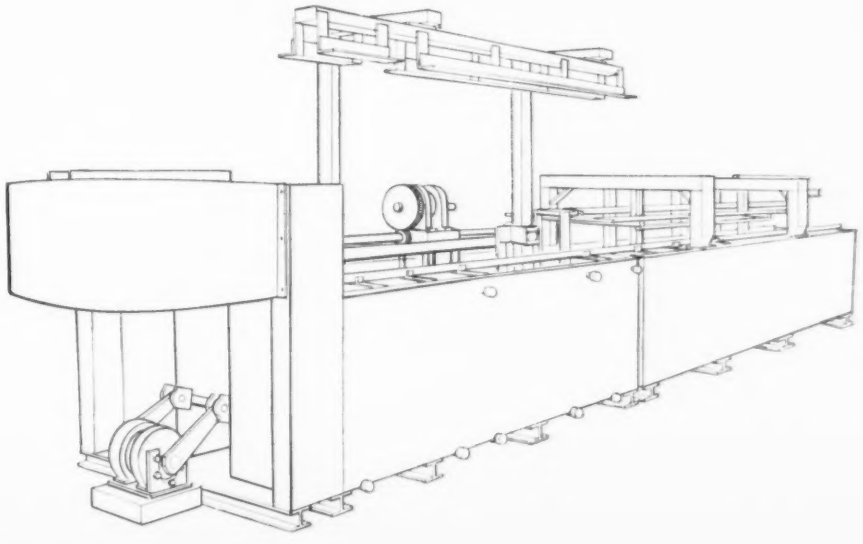
This new production plating mechanism incorporates most of the work-saving features of expensive, custom-built automatic plating conveyers. But, because of its standardized design, many costly engineering hours are saved and the savings passed on to the buyer.

Among the Platocrat's unique features are: (1) a replaceable plating tank which enables the plater to change from cadmium to zinc in minutes, without the usual time-consuming tank cleaning operations. One tank is simply pulled aside and replaced with a spare tank. (2) The plating tank is electrically isolated from the rest of the mechanism to eliminate the possibility of stray currents. (3) Three-point rail contact of work-carriers assures constant, dependable current flow. (4) A versatile cycle allows as many as seven stations in both the pre- and post-plating cycle. Tanks are sectionalized at the factory to particular needs. (5) Racks are 12″ x 6″ x 50″, provide big parts carrying area for higher production.

The machine is completely hydraulically powered for smooth parts transfer. One 3-H.P. motor runs the entire mechanism through two hydromotors, one for horizontal motion and one for vertical movements. All transfer and conveying mechanism is mounted on a reciprocating carriage located between the two rows of tanks. This entire carriage mechanism is suspended on rollers moving in a channel track.

Two basic movements bring parts through the full plating cycle, one forward and reverse straight line horizontal motion and one raising and lowering vertical movement.

Plating racks are attached to work-



From Wyandotte . . . answers to modification & maintenance problems

At Wyandotte's modern research center (above), performance-proven products are developed and tested. Practically any cleaning problem can be duplicated and studied. In addition to huge plants in Wyandotte, Mich.— Wyandotte's vast facilities for producing specialized cleaning products include a new plant in Los Nietos, California.

	YOUR PROBLEM	ANSWER	DESCRIPTION
1	Steam cleaning	Altrex*	Cuts scale formation; removes all types of soil from aircraft exteriors, decks, engines.
2	Emulsion cleaning	1-2364	Meets USAF Specification 20015-E and MIL-C7122 (Aer). Will not craze plastics.
3	Carbon removing	P-1075	Nonflammable, noncorrosive cold-tank carbon remover for jet- and piston-engine parts.
4	Integral fuel-tank desealing	2789	A "universal" desealant for removing all types of sealing compounds. Nonflammable.
5	Removing exhaust stains	#20	Removes stubborn exhaust stains; prevents corrosion in exhaust-stained areas.
6	Washing aircraft exteriors	Aerowash LR231	An excellent emulsion cleaner for regular aircraft maintenance.
7	Paint removing	Sprazee	Aircraft paint remover. Meets Specification AF-14119-C.
8	Engine test-cell cleaning	El-Bee*	An all-soluble cleaner for removing dirt, oil, and grease from concrete surfaces.
9	Washing-machine cleaning	397	A special low-foaming, non-etching aluminum cleaner. Meets Specification MIL-C-5543.
10	Aluminum brightening	Alutone*	Brightener for exterior aircraft surfaces. Cleans and brightens in a single operation.
11	Floor absorbent (anti-slip)	Zorball	An all-purpose floor absorbent; makes floors skidproof, safe at lowest use-cost.

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AIRCRAFT DEPARTMENT 2321 • Wyandotte, Michigan

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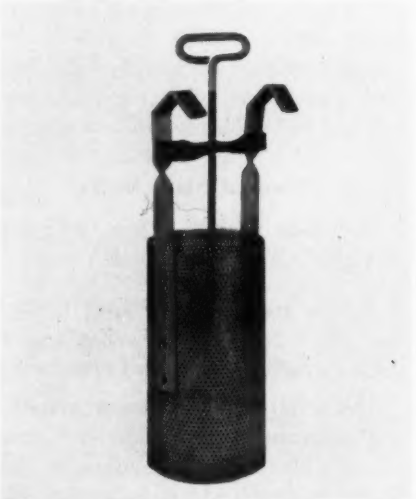
carriers at the loading station; a low cost, hydraulically operated automatic loader is available as optional equipment. When the machine is started, lifting arms fixed to the carriage engage the work-carriers being transferred and lift them at all points on one side of the machine, carry them forward to the next station where they are lowered and disengaged from the lifting arm. This sequence is simultaneously produced in reverse on the opposite side so that, when the lifting arms are lowered on one side, they are raised on the other side. In the end tank, the work-carrier is advanced by means of a reciprocating arcuate rail actuated with the carriage movement.

Lubrication is centralized, quickly accomplished with an effortless push of a button. The machine requires a minimum of head-room (only 9-feet) since there is no overhead superstructure. Its compactness makes for easy shipment in two sections and for fast, inexpensive installation.

Perforated Metal Anodizing Basket

Wiretex Mfg. Co., Inc., Dept. MF, 40 Mason St., Bridgeport, Conn.

Anodizing of small metal parts, such as screws, nuts, camera parts, etc. are easily handled in this new aluminum anodizing basket. Constructed of aluminum, welded and riveted, it features an adjustable cover to hold the

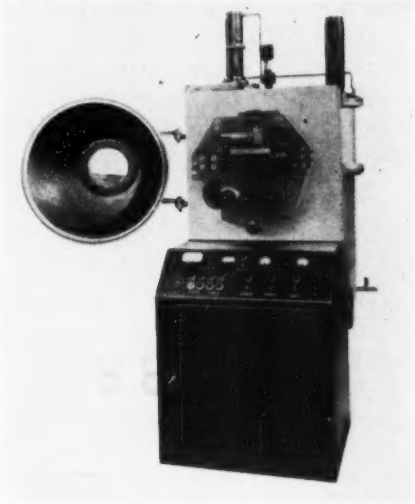


correct amount of tension on the parts, depending on the load carried. It is 6¼" x 24" overall, with the aluminum handle and threaded bar ½" in diameter. The basket is made of 11 gauge aluminum with a ⅛" perforated hole, staggered ⅜". The hang-

ers are 1" x ⅛" aluminum flat stock, riveted to a copper flat stock bar.

Continuous Roll Vacuum Metallizer

F. J. Stokes Machine Co., Inc., Dept. MF, 5500 Tabor Road, Philadelphia 20, Pa.



The new metallizing equipment represents a completely new approach to the problem of continuous deposition of metal on a moving web of material. Previously, continuous roll metallizing of plastics, paper, or textiles has been done in a dual-chamber set-up, with the base material being out-gassed in one vacuum chamber and then transferred to a second chamber to receive the thin coating of metal deposited by evaporation.

The new units have only a single vacuum chamber and thus need only a single vacuum pumping system. This makes them more compact, taking up much less floor space, and saves considerably on capital investment. And the new continuous metallizers coat the base material faster than previously available equipment according to the above manufacturer.

The units can coat material in widths of 6 inches, 24 inches, 36 inches, 48 inches, 54 inches, or 60 inches, at speeds up to 500 feet per minute. Rolls up to 24 inches in diameter can be accommodated in the units, and material ranging in thickness from .0005 in. up to .0020 in. can be successfully coated on a continuous basis.

The metallizing units are designed to deposit a brilliant, uniform coating of metal over the entire width of the material with no dark or "burned" areas. They incorporate an ingenious device for continuously supplying the

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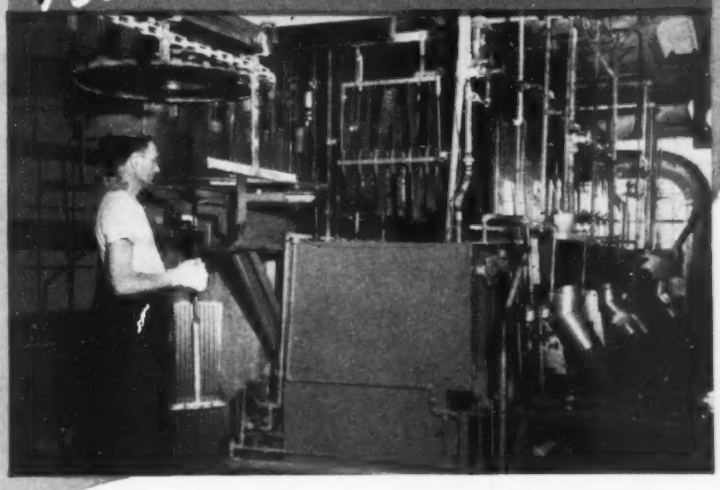
Nalcite® ION EXCHANGERS



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- RECOVER RINSE WATER
- INCREASE PRODUCTION
- IMPROVE QUALITY
- RECOVER VALUABLE METALS
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You can solve major waste disposal or water conservation problems... and get *five extra advantages*...with the Nalcite Ion Exchange process in your plating or anodizing plant.

Check these plus benefits in the list at left. They are important contributions to efficiency and economy in plating processes. We invite you to write, today, for full information on Nalcite Ion Exchangers.

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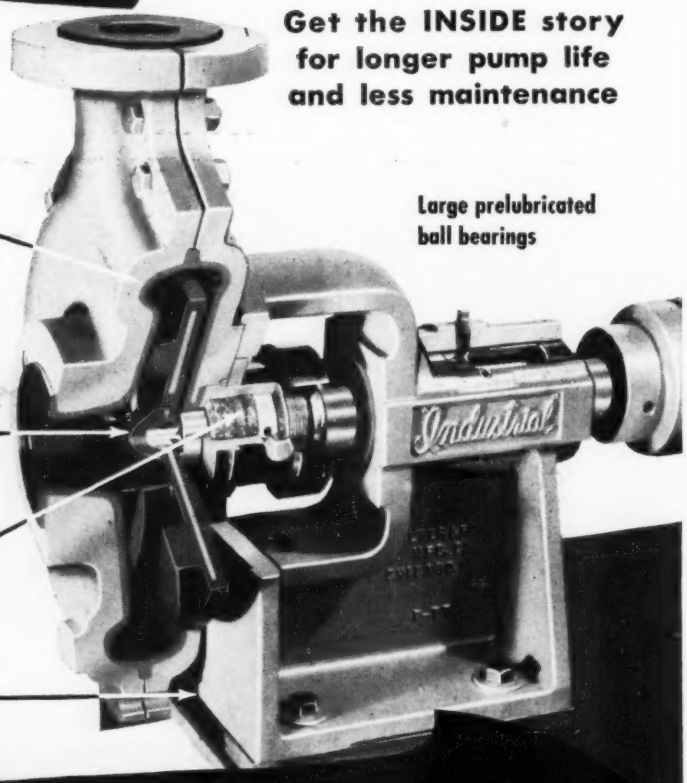
CORROSION...ABRASION...VIBRATION?

Get the INSIDE story for longer pump life and less maintenance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pure metal to be deposited. An observation-port set into the cover of the unit, plus a fluorescent light source placed behind the coated film, allows the operator to check the uniformity and quality of the coating continuously, during the deposition process, and to adjust the speed of travel of the material through the evaporation chamber so as to obtain the desired thickness of metal deposit. Air-actuated poppet valves, push-button controlled from the front panel, simplify the operation of the units.

Barrel Deburring Compound

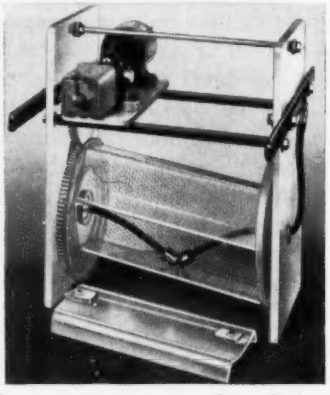
Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

Oakite FM 184, a mildly acidic compound for barrel deburring, descaling, and derusting, was specifically designed by the company's laboratories to replace raw acids in barrel operations, where alkaline materials and abrasives are impractical because of time limitations. It is also designed to improve color of steel after alkaline deburring; to remove heat scale from steel; and to brighten brass, either with or without the use of abrasives.

The material is said to have good foaming properties at the recommended concentrations of 1 to 3 ounces to the gallon of water. It may be added dry to the burnishing barrel.

Double Oscillating Cylinder for Barrel Plating

Belke Mfg. Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.



More even exposure of work for uniform metal deposit in barrel plating is afforded by a new double oscillating cylinder, it is claimed.

Eccentric mounting raises and lowers opposite ends of the cylinder as it rotates. The double oscillating motion moves the work in and out — away from the cylinder ends — back and forth across the cylinder. No parts remain shielded by the cylinder ends.

All parts are exposed to plating current with uniformity that produces a deposit of specified thickness in less time and with less metal. The added motion, with no increase in cylinder speed, helps break apart washers and other objects that tend to stick together.

The double oscillating cylinders are furnished for barrels of all sizes from large 14 x 30s to small 6 x 12 portables. Literature on request.

Plastic Tanks

Valco Corp., Dept. MF, 1710 Roblyn Ave., St. Paul 4, Minn.

A new line of fiberglass plastic tanks for service under corrosive conditions is claimed to include improved fabrication and special reinforcement at points of stress concentration. The new, improved resins that are now being used in these tanks give excellent resistance to most acid and alkaline solutions.

The interior surfaces of all the new tanks have a smooth resin finish. Heavy glass cloth and glass fiber mat are used as reinforcement throughout. Better fabrication methods insure maximum strength and corrosion resistance.

Many shapes and sizes are available —round, square, and rectangular, from a tiny 6-inch cube to a mammoth 14-foot tank, 4 feet deep and 5 feet wide. They may be had molded in one piece or fabricated from standard panels. Machine-made fiberglass reinforced plastic ducting and pipe are also supplied with these tanks for handling corrosive liquids and gases.

Industrial Apparel of Acid-Resistant Orlon

Worklon, Inc., Dept. MF, 253 West 28th St., New York 1, N. Y.

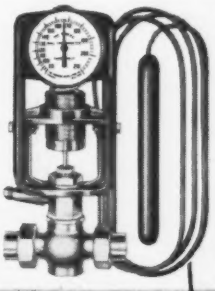
Augmenting an already extensive line of Orlon work clothes, the manufacturer announces the introduction of additional apparel items made of the

GOLD is costly to plate
DON'T WASTE IT!

Even with traps installed to recover gold, you're *wasting* it...

IF you have to replate frequently
IF solution decomposes
IF there is excessive evaporation

Correct temperature regulation will help eliminate this loss of valuable gold, time and labor.



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For plating tanks and other metal finishing processes. Powers Controls quickly pay back their cost by accurately holding solutions at a constant uniform temperature.

Write for Bulletin 330

4

POWERS

TECHNICAL DATA SHEET

GOLD

IF you plate — GOLD

Too high a temperature can result in:

1. Excessive build up of carbonates.
2. A tendency to spongy deposits.
3. Excessive evaporation.
4. Color variance.
5. Low cathode efficiency.

Too low a temperature can result in:

1. A low limiting current density.
2. Pale deposits.
3. Dark deposits.
4. Inclusion of foreign metals in the deposit (lower carat).

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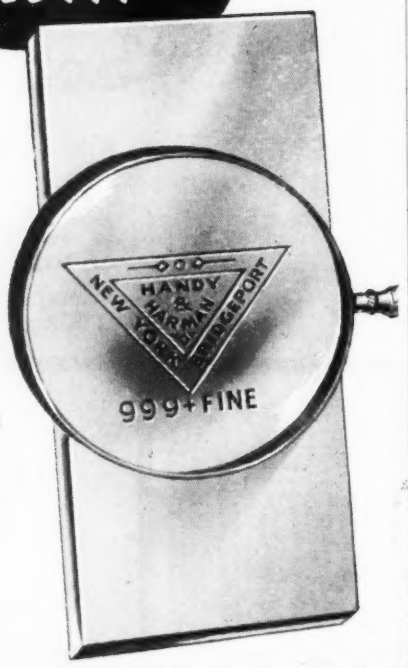
(c32)

YOU'LL HAVE NO SILVER PLATING TROUBLES...



...if you use anodes stamped "999+FINE"

Plating troubles due to impurities in ordinary silver anodes just can't happen when you use Handy & Harman "999 + FINE" anodes. That's because all impurities that can cause plating troubles are removed from these anodes in their manufacture. That "999 + FINE" mark also assures you of highest standards of fineness and constant uniformity from anode to anode. When you buy anodes always specify Handy & Harman "999 + FINE", and cut your silver plating costs.

REFINING—*Send your silver plating solutions and other precious metal scrap, sweeps and waste to us for refining. Scientific methods, skilled personnel and over half a century of experience assure you of an accurate return from every lot.*

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Du Pont fiber. These include underwear ("T" shirts and shorts), fitted work gloves and complete matched sets of uniforms consisting of caps, jackets, trousers, and shirts. All these garments give the wearer the unique advantages of Orlon, notably year-round comfort, handsome appearance, plus exceptional resistance to corrosive chemicals.

The Orlon fabrics used for the industrial apparel are especially applicable to on-the-job needs because they resist damage by abrasion, by heat, cold and sunlight, by greases, paints, moisture, by acids and acid fumes. No dry cleaning, no special care is needed. They wash easily, dry quickly, require little or no pressing.

Centrifugal Dryer

New Holland Machine Co., Dept. MF, New Holland, Pa.

Manufacturers with a need for fast drying small parts will find the new Model 20 Kreider double-action centrifugal dryer a real production booster, according to the above manufacturer of the unit..

Capacity of the new unit goes up to 75 pounds of small parts. The machine can dry a basket of small parts in as little as 15 seconds. The high speed drying is due to an improved exhaust system which allows the moist air to pass completely out of the dryer, rather than be blocked in the bottom of the machine.

Air is sucked down over the spinning basket by the turbine at the base of the spinner. Still faster drying is possible by heating this air with optional electric or steam heating units that fit compactly into the cover of the dryer. The large electric Chromalox 2,350 watt element can heat the air to 160°.

High speed-825 R.P.M.-whirling action gives basic drying power to the dryer. Safety features include an interlock that prevents the possibility of the operator opening the cover without using the foot brake to stop the machine. The dryer can't be started with the cover open either.

A magnetic starter with a reset button prevents the possibility of overload and damage to the machine. Easy-to-reach grease fittings and removable housing make dryer easy to service and a moisture shedding motor, taper end roller bearings, a sturdy spinner, and heavy duty cover are stated to give it long life.

Anodized and Dyed Aluminum Strip

Fromson Orban Co., Inc., Dept. MF, 261 Madison Ave., New York 16, N. Y.

Continuously anodized and dyed aluminum strip in coils is now available for the first time in this country through the sole American distributor.

More economical than batch anodizing, the continuous anodizing process provides a non-tarnishing finish, which is consistent and uniform throughout the coil, with no visible electrode contact marks. Roll forming and stamping operations are also simplified, since the coils are adaptable to automatic feed.

The new metal, which may be dyed

in many colors, including gold or brass tones, is available in commercial coils in gauge ranges from .003″ to .020″, and widths from ¾″ to 20″.

Contols for Zeolite Softeners

Graver Water Conditioning Co., Dept. MF, 216 W. 14th St., New York, 11, N. Y.

A new automatic control system for dual tank zeolite softeners is part of a completely pre-engineered zeolite softening unit including electrical control panel, flow meter, automatic multi-port valve, zeolite softeners, brine measuring tanks and connecting lines..

The outstanding feature of this system is a new electrical control panel containing a series of relays and a multiple-cam timer which initiate periodic, timed regeneration of the softeners.

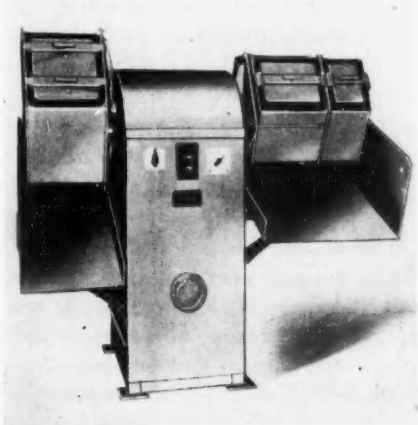
Incoming raw water is measured by an inlet water meter register. When a predetermined volume of water has passed through the meter a contact automatically closes beginning the regeneration circuit. One relay is immediately locked in while another is locked out so that only one softener will be regenerated at a time. This relay in turn starts the timer motor which rotates a cam shaft through a series of switches each of which positions the multi-port valve for successive backwash, inject-displace, rinse and service operation.

If desired, manual controls can be substituted for both the inlet meter register and the automatic multi-port valve.

Tumbler Handles 3 Vari-Sized Loads at Once

Rampe Mfg. Co., Dept. MF, 14915 Woodworth Ave., Cleveland 10, O.

Unequalled for speed, economy, convenience and versatility and a boon to the plant with many various sized loads to tumble, the new type Super Twin barrel finisher is claimed to speed up tumbling operations at a saving of both time and money.



The three different sized barrels which are fitted to this unit are a 2 cu. ft. barrel—10¾ x 23″ size; a 1.1 cu. ft. barrel—10¾ x 17″ size; a 5 gal. barrel—6¾ x 17″ size. The two smaller barrels are on one side of the unit with the 2 cu. ft. barrel on the other, balancing the loads on either end of the shaft.

Specifications of this new tumbler include: anti-friction ball bearings throughout; Motor ¾ H.P. 220/440, 3-phase; variable speed drive from 12 to 36 R.P.M.; water tight push button switch and magnetic starter. Barrels can be furnished with vinyl plastic lining. Safety type barrel covers prevent pressure build-up.

Special attention is called to the movable chutes on the unit illustrated. These chutes tilt forward and backward to aid in draining off liquids and materials separately. When tilted backward the chutes form a safety guard around the barrels.

Mixed-Bed Demineralizer

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

For the demineralization of relatively small quantities of water, up to 360 gallons per hour, a compact unit, the Model MBD-15 demineralizer contains a resin bed consisting of an intimate mixture of cation exchanger,

"218X" is TOUGH

...and flexible, too

Racks with Unichrome Coating 218X can take not only hard use but even abuse. So tough is this heavy duty flexible coating, it resists scuffing, won't tear or chip. It maintains sleek, smooth, tight protection in severest plating operations . . . rinses freely to minimize drag-in and drag-out problems.

Chemically, too, it's tough. Use this green, plastisol coating in all plating, cleaning and anodizing operations, even with vapor degreasing cycles . . . and you'll see service you didn't think possible.

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From surface preparation to finished product, this 3 step Promat process assures brilliant, corrosion resistant zinc deposits at high current densities.

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7073 addition agent. For muriatic and sulfuric acid pickling solutions.

PLATE WITH PROMAT

C42 and B4M bright addition agents. Permits current densities up to 200 amps per sq. ft. Improves conductivity for excellent distribution of fine grained, high luster, durable deposit.

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PROSEAL 9 and 2B leach . . . Easy and inexpensive to use and provides maximum control over uniform application of film in full bright or bronze phase.

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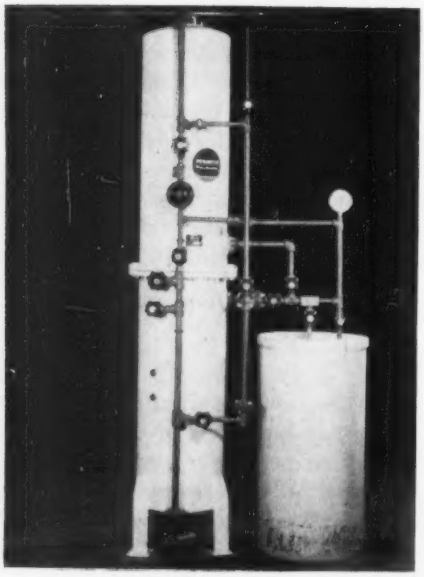


Permutit S. It will produce a water of low total dissolved solids, low CO_2, low silica content and extremely low conductivity.

The manufacturer claims that the treated effluent from this unit will have an average conductivity of 0.15 micromhos which is equivalent to approximately 6,000,000 ohms-c.m. specific resistance or 0.05 p.p.m. total electrolyte content. Also, carbon dioxide will be reduced to 0-1 p.p.m. and the silica to about 0.1 p.p.m.

Flow rate of the device is 6 g.p.m. average to 7.5 g.p.m. maximum. It has a kilograin capacity of 24,000 grains total dissolved solids and is capable of teating 4100 gallons of raw water containing 100 p.p.m. total electrolytes. The mixed-bed tank, containing 5.4 cubic feet of resin, is 15 inches in diameter, is 7 feet 7 inches in overall height and is protected with 6 coats of Heresite lining.

When the unit is exhausted, the resin bed is regenerated with 12 pounds of sulfuric acid for the cation exchanger and 20 pounds of caustic soda for the anion exchanger. The same regenerating tank is used alternately for both the acid and caustic soda regenerants.

Neoprene Gloves

Pioneer Rubber Co., Dept. MF, Willard, O.

A complete innovation in industrial gloves of flock-lined neoprene, the new Stanzoil NS-35 features a lining of thousands of tiny cotton particles bonded to the inside of the milled neoprene outer glove. Besides giving the wearer a maximum amount of comfort without decreasing finger dexterity, the glove has an effective molded non-slip grip on fingers and palm.

Chromate Coating for Aluminum

The Chemical Corporation, Dept. MF, Springfield, Mass.

Luster-On Aluminum Sealer 222-M is claimed to produce a chromate film on aluminum that provides excellent corrosion protection and can serve as a paint base. The new sealer replaces anodizing where hardness is not a prime factor and has salt spray resistance to 600 hours.

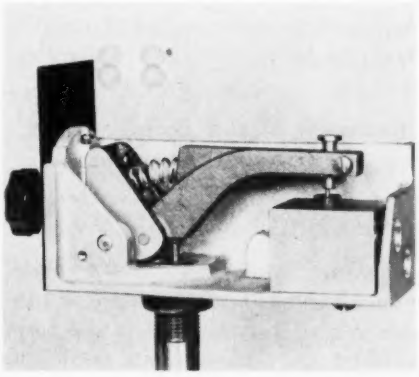
The sealer is easily applied in one dip at room temperatures; it adheres well and does not leach easily. It can be dyed in many attractive pastel colors and meets government specification MIL-C-5541. Literature is available from the above manufacturer.

Pneumatic Temperature Control

Burling Instrument Co., Dept. MF, 16 River Road, Chatham, N. J.

The new Model DA is designed for use on all installations where temperature is to be controlled by varying the flow of gas, steam, or other medium with an air-operated valve or motor.

It may be used in any pneumatic system up to 50 p.s.i.g. and will reduce the output or branch line pressure as temperature increases. Since it operates by the differential expansion of solids and uses no liquid or vapor fill, it is available for temperatures up to 1800°F.



Temperature adjustments are made with knob on front of case. Throttling ranges are fixed, but may be specified as narrow as 5 degrees or as wide as 100 degrees.

Control is obtained by the difference in expansion of two concentric tubes actuating a pilot valve through a lever. Outer tube may be brass, stainless steel, or special alloys, and threaded mounting fittings may be supplied when required.

Acid Hose

Hewitt-Robins, Inc., Hewitt Rubber Div., Dept. MF, Stamford, Conn.

Maltese Cross acid hose is stated to be made from an exclusive company formula, using Dupont's Hypalon as basic polymer, highly resistant to acids, alkalies and chemical solutions. The hose covers are made from pure gum rubber and the ends are protected by thick rubber caps to prevent liquids from penetrating into the carcass.

The hose is claimed to be resistant to hot chromic acid solutions and cold nitric acid up to 70% concentration. It is furnished only with straight ends, in inside diameters of ½" to 3" and working pressures of 95-200 lbs. Maximum lengths are 50 feet.

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This new Magnus bulletin is the last word on metal cleaning . . . techniques, equipment and cleaning materials. It will help you cut costs, speed cleaning and improve quality.
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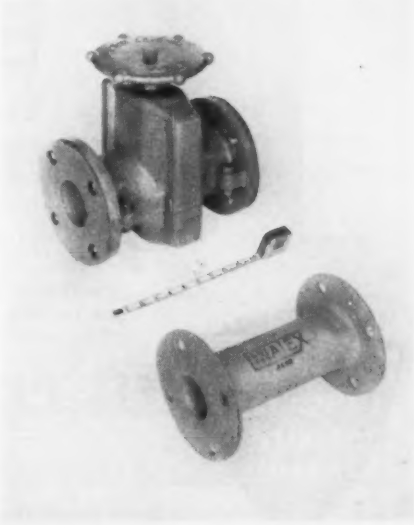
Pinch Valves

Linatex Corporation of America, Dept. MF, Vernon Ave., Rockville, Conn.

A new pinch valve has a patented totally enclosed housing which eliminates danger of spillage. Double acting jaw closure gives unobstructed full bore flow in open position and assures free flow without clogging in any throttled position. Easily replaceable sleeves are constructed of abrasive resistant Linatex, or synthetics, as required for highly oxidizing acids or other corrosive liquids which cannot be handled with a natural rubber material. Manufactured in sizes 1½"



ROUND LEAD ANODES FOR CHROMIUM PLATING NOW AVAILABLE IN 4 Diameter Sizes!

- Standard
- Medium
- Heavy
- Super R

LARGEST SELECTION OF DESIGNS AFFORDS SAVINGS TO YOU

Now it is possible to select a round lead anode that will most economically suit your specific requirements. It is no longer necessary to purchase excess lead in order to obtain the numerous benefits of round anodes. Save by pin-pointing to your exact needs!

LARGEST SELECTION OF HOOK STYLES

Six standard styles of knife-edge hooks #A1 through A7 afford positive contact and assure having the hook to meet bus bar and solution level requirements.

Two heavy duty flat face hooks are available to handle your greater current carrying capacity needs. Flat bent copper hooks can readily be made to your specifications.

Products of Heil Process Equip. Corp. are sold through all leading electroplating jobbers — On your next order, specify Heil Round Lead Anodes.

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HEIL PROCESS EQUIPMENT CORPORATION

12901 Elmwood Avenue • Cleveland 11, Ohio

Write for Bulletin R-92 on Heil Round Lead Anodes

through 6", cast iron or aluminum body for standard schedule 40 pipe flanged connection. Write for Bulletin L-102.

Acid-Proof Coating for Concrete

The Ceilcote Company, Inc., Dept. MF, 4908 Ridge Road, Cleveland 9, O.

Corocrete is a new corrosion-proof material which protects the floor area surrounding acid tanks. Developed for application directly over concrete, this new material is composed of three basic ingredients: (1) a thermosetting resin liquid, (2) a hardening agent and (3) an aggregate-type filler. Abrasion resistance is claimed to be two to four times greater than concrete and, in addition, the material is stated to be four times stronger than concrete.

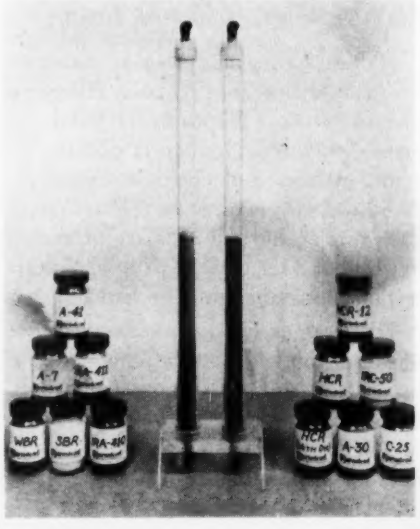
Research Model Demineralizer

Barnstead Still & Sterilizer Co., Dept. MF, 129 Lanesville Terrace, Forest Hills, Boston 31, Mass.

The new Model RE-1 research demineralizer has been developed to provide a laboratory with all of the basic material and reference data needed to explore the properties of twelve of the newest cation and anion resins in both highly basic and weakly basic types.

The complete unit consists of two transparent Lucite ion-exchange columns, twelve jars of resins of assorted types, five cation and seven anion, and a manual of more than 100 pages of technical data on the resins. Instructions for operating as a mixed-bed or a two-bed ion-exchanger are included and additional units can be connected in series for multiple-bed experiments.

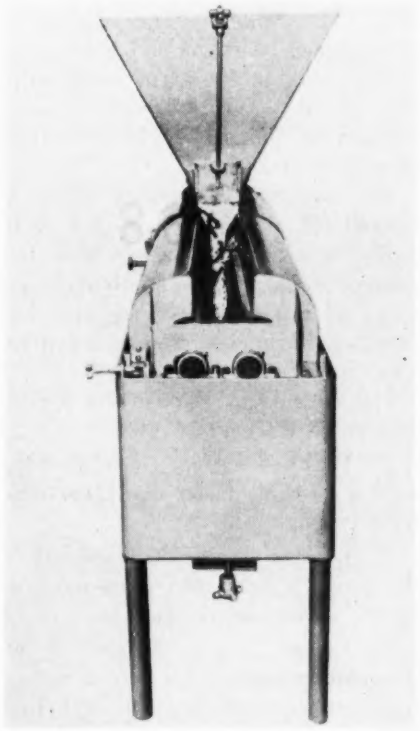
This new ion-exchange kit can be used for research or as a demonstra-



tion unit, and should prove an effective teaching or instruction aid. It permits experiments on a small scale so that results are quickly available. The manufacturer states that the complete kit will be priced at $69.00 for two column unit, twelve resins and the technical data manual.

Barrel Finishing Separator

Tumbling Sales & Service Co., Dept. MF, 18 Beech St., Byram, Conn.



The Esbec Dimensional Separator will make separations which cannot be made either magnetically or by screening. It is not intended as a substitute for either of these methods but takes up where they leave off and will make separations which otherwise can only be done by laborious hand picking, according to the above manufacturer.

Some of the most striking examples of its abilities are the following separations:

Needles and needle-like parts from steel balls.

Non-ferrous parts from chips of the same general size.

Ferrous parts from ferrous media.

Flat parts or chips from round ones.

Thin flat shapes from thick pieces of the same length and width.

Dissimilar parts which have been processed in the same load for economical or production reasons.

Dissimilar parts which have been mixed by accident.

Flat chips which cannot be screened

These ANODES cut costs

These are Federated's exclusive Conducta-Core anodes, the most economical lead anodes for modern chromium plating operations.

Conducta-Core anodes last up to three times as long as other lead anodes. The highly conductive and non-contaminating aluminum core rod runs the full length of the anode so they cannot warp or buckle. The Conducta-Core anode is designed with a greater number of high projections to give much improved throwing power and openings to provide self-cleaning action.

Let Federated serve as your single source for all plating materials. Copper, lead, zinc, tin, cadmium, brass and other non-ferrous anodes; high-quality full nickel content nickel salts; Zimax brighteners, in liquid and powder forms, for all types of zinc plating; Cadmax liquid brighteners for cadmium plating.

Think of Federated first when you need quality plating materials. Write directly to us for additional information on any of our plating products. Or get in touch with your nearest Federated Distributor.

Federated Metals

DIVISION OF AMERICAN SMELTING AND REFINING COMPANY
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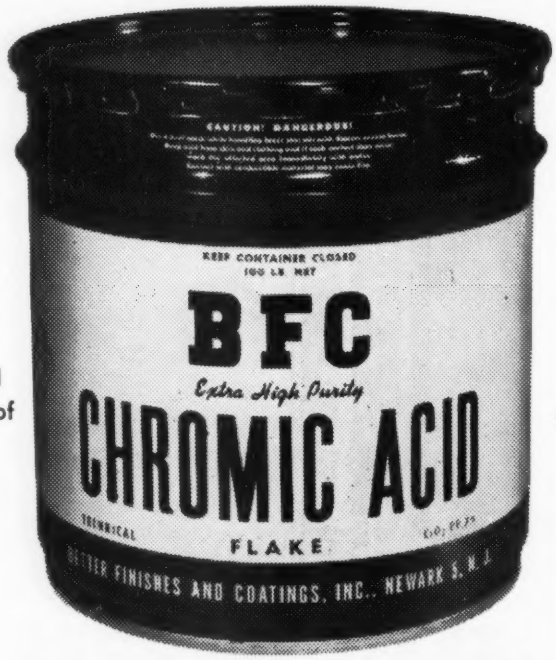
99.75+% PURE
CHROMIC ACID
TECHNICAL GRADE—FLAKE



Ownership-management make the difference! We say exactly what we can do... and then do it without alibis or buck-passing. We think you'll like the uniform quality of BFC Chromic Acid and the single-standard-of-service behind it. When you're in the market, why not telephone us at MArket 3-6700?

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268 Doremus Ave., Newark 5, N. J. • 2014 East 14th St., Los Angeles 21, Calif.

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from the chip load but which are subject to wedging in parts.

Mixed loads of steel media to eliminate sizes which might wedge, but which cannot be screened.

Grading of burnishing balls to eliminate sizes which might wedge in holes.

Grading of tumbling chips to eliminate sizes and shapes which might cause wedging.

It also permits the tumbling department to use the sizes and types of media best suited to the individual job but which could not be separated from the work either by screening or magnetically.

Separations are made by reason of difference of critical dimensions of parts or chips. Four different micrometer type controls quickly adjust the separator for changes in size of material, hopper discharge, rate of feed, and rate of discharge. These, combined with a three speed drive, give the separator great flexibility and adapt it to a wide variety of jobs.

As the separator is fully automatic, it saves many man hours by releasing the operator for other duties while the separation is being made.

Aluminum Cored Lead Anodes

Knapp Mills, Inc., Dept. MF, Wilmington, Del.

Aluminum-cored lead anodes for use in chromium plating and sulphuric acid electrolytic processes, have been developed by Reynolds Metals Co., working jointly with Knapp Mills.

Many attempts have been made to offset the low conductivity of lead by designing anodes in irregular and corrugated shapes for maximum surface area. Copper cores encased in lead are also used. Copper cored anodes materially improve the overall conducting efficiency. However, wherever the core becomes exposed through careless handling or accidental abrasion during processing, the electrolyte causes dissolution of copper.

Aluminum cores offer the ideal solution. The anodes are physically strengthened, the overall conductivity is high and, in the event of an ultimate break in the lead cladding, dissolution of aluminum will not cause harmful contamination.

The aluminum-core anode utilizes a rectangular aluminum bar clad with lead. The anode top forms a hook for efficient contact to the bus bar. Other forms of aluminum may be used for custom-built anodes on special plating jobs.

The advantages claimed for aluminum cored lead anodes are:

1. High electrical conductivity, making possible faster and more uniform plating.

2. Greater dimensional stability—the anode is held in a fixed position by the strong aluminum core.

3. Longer anode life—arc-off at the solution level is minimized, reducing corrosion attack to a negligible amount.

4. Competitive cost—the price is expected to be comparable to many of the solid lead anodes now used.

5. Less weight—aluminum cored anodes weigh appreciably less than solid lead anodes. Handling problems in anode removal for cleaning will, therefore, be simplified.

Pretreatment for Porcelain Enameling

Parker Rust Proof Co., Dept. MF, 2177 E. Milwaukee, Detroit 11, Mich.

A new material, developed by the above company, is claimed to be the key to a new method which allows the application of the porcelain enamel finish coat directly to ferrous metals. The new material, called Pre-Namel 410, has demonstrated that it delivers improved physical characteristics of the finished product, with important reduction in costs through by-passing the conventional ground coat and nickel flash steps.

In exhaustive tests the special metal treatment provided by the new process is stated to have produced (1) reduction of coating thickness with consequent reduction of damage from torsion and cross-bending (2) straighter parts with less bowing between front and back sides (3) an indication of fewer rejects and (4) a reduction of the number and types of enamel frits required.

Tests indicate that the process eliminates the need for a special premium base metal; applies successfully to cold rolled rimmed steel and enameling iron; permits application of standard finish coat porcelain enamels direct to steel; produces completed parts meeting the best acceptance tests for standard porcelain enamel.

Non-Tarnishing White Plate

Danmark Cunit, Inc., Dept. MF, 125 Ivy St., N. E., Atlanta, Ga.

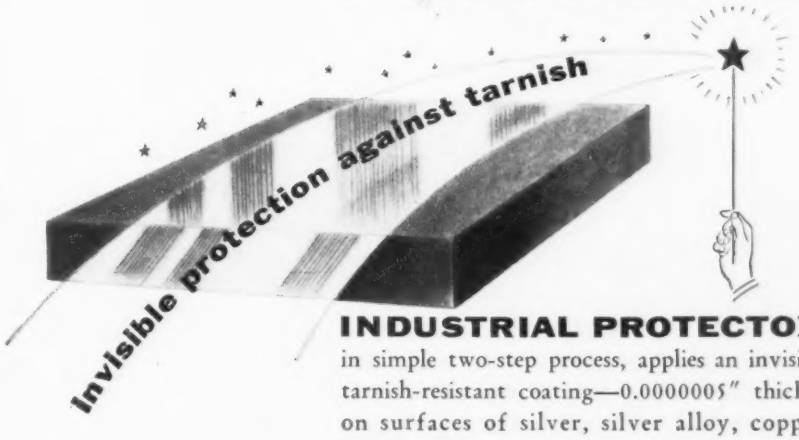
A distinctive new plating process known as Cunit has been recently perfected in Denmark on a commercial scale and is now available in America under licensing arrangements. The finish closely approximates polished sterling silver in appearance, and has a soft, lustrous, brilliant finish, yet does not tarnish and never needs polishing, according to the above company. It is an alloy consisting principally of copper and tin and can be applied over steel and most non-ferrous metals at a cost comparable to nickel plating. Intermediate between nickel and chrome in hardness, it is highly scratch resistant. The alloy is readily applied in a high and exceptionally uniform quality, making it especially suitable for tableware, electrical appliances, and the many other products that depend on a high degree of eye appeal for volume sales.

In order to develop the bright luster characteristic, buffing is necessary, but it is claimed that since the alloy can be applied directly to steel, it is cheaper than the copper-nickel-bright chromium method in many instances. The high melting point of the deposit combined with its impervious coating has led to its use in certain case hardening applications with excellent results.

It is said that most plating facilities can be converted with a minimum cost. The principal requirements are for a heated tank for the plating solution and a ventilating system to carry off fumes developed in the process.

Samples and details of Cunit plating are available from the company. The firm will plate test items for interested manufacturers for comparison purposes.

Technic **INDUSTRIAL PROTECTOX**



INDUSTRIAL PROTECTOX, in simple two-step process, applies an invisible tarnish-resistant coating—0.0000005" thick—on surfaces of silver, silver alloy, copper, brass, gold.

★ **Anti-tarnish for work in open trays, storage, shipment**

★ **Resistance to sulphur fumes, other industrial atmospheres**

★ **Excellent lacquer base, improves adherence 300%**

★ **Film easily removed without pre-treatment when desired**

Protectox treated surfaces are easily soldered—treated contacts may be built into relays and other equipment without pre-treatment or after treatment. Send for "Industrial Protectox" Data Sheet—full details, application procedures, cost, etc.

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Please send "Industrial Protectox" Data Sheet.

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Scrubbers for Corrosive Fumes

Heil Process Equipment Corp., Dept. MF, 12901 Elmwood Ave., Cleveland 11, O.

A new series of fume scrubbers is designed specifically for cleaning acid and other corrosive fumes. Designated the 720 Series, they are particularly suited to pickling operations, electroplating process, and anodizing installations, or other corrosive fume producing systems, and are available in eight standard sizes from 1,000 C.F.M. to 30,000 C.F.M. in the following materials of construction:

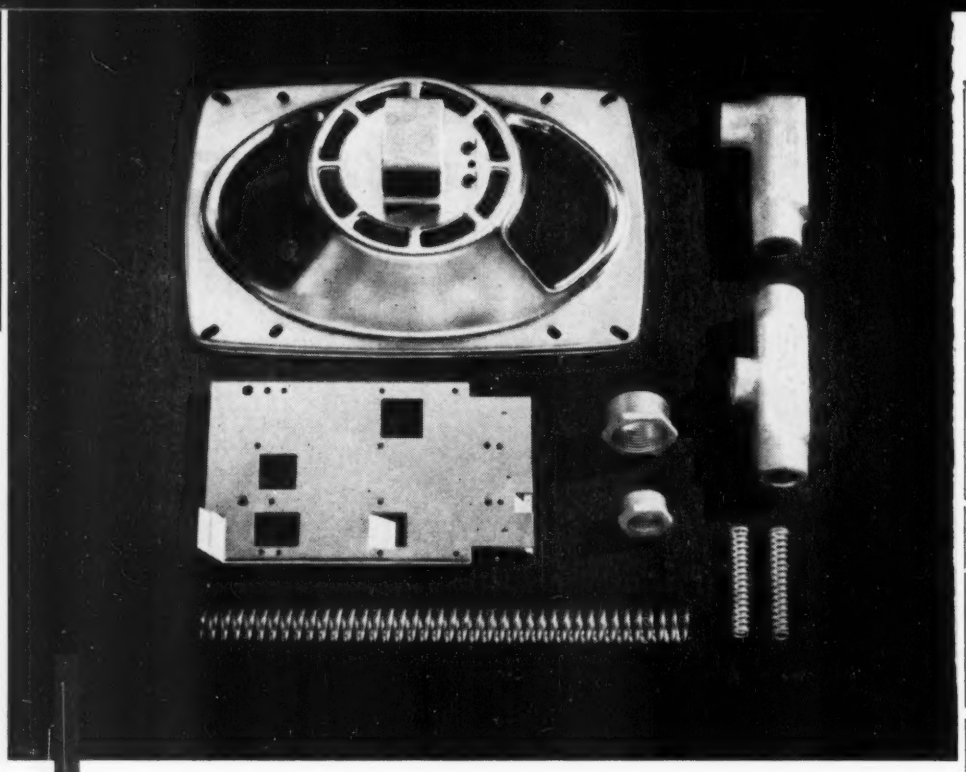
Rigidon (glass reinforced plastic) for most acids including hydrochloric, sulphuric, phosphoric, and nitric.

Rubber-Lined Steel for hydrochloric, sulphuric, phosphoric, and most acids as well as caustics.

Carbon Steel for most caustic and chromic acid fumes.

Other Alloys available for special applications.

Lower maintenance costs are possible because there are no moving internal parts or packing to clog up or to be replaced. The scrubbers operate on the principle of water spray



A FINER CADMIUM PLATING PROCESS

Udylite Bry-Cad Process Gives the Faster and Brighter Cadmium Finish

Newly developed by Udylite research, Bry-Cad offers many interesting applications for cadmium plating.

Springs—Bry-Cad provides excellent protection with a minimum of hydrogen embrittlement.

Electronic Assemblies—Bry-Cad's low electrical contact resistance is highly desirable on assemblies put together with fasteners. An excellent surface for rapid soldering.

Malleable Iron Castings—Bry-Cad gives unusual coverage not obtainable with similar rustproofing finishes.

Stainless Steel Aircraft Parts—Bry-Cad does not cause embrittlement of stainless steel parts subjected to high temperature.

Udylite Bry-Cad has other advantages such as: High cathode efficiency, simplicity of operation and control, attractive finish with less tendency to finger mark, a self-lubricating metal and good resistance to mild alkalies. Bry-Cad is easily adapted to plating in barrels, hand operated tanks, semi-automatics or full automatic machines.

The Udylite Bry-Cad process is just one of the many electroplating processes pioneered by Udylite. Whether your need is for a process, equipment or supplies—be sure to consult your Udylite representative or fill out coupon and mail to us direct.

WORLD'S LARGEST PLATING SUPPLIER

Please have a sales representative call on us concerning Udylite's Bry-Cad plating process. Have him ask for:

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COMPANY _____

STREET _____ ZONE _____

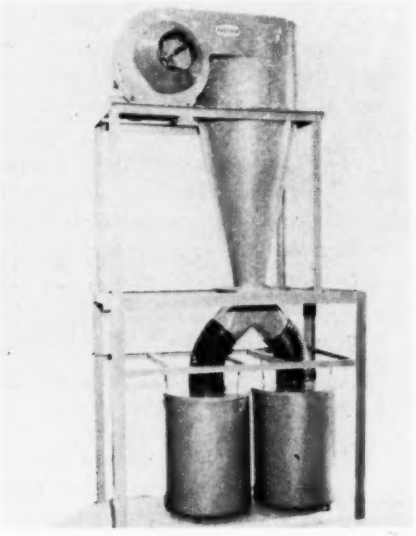
CITY _____ STATE _____

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

absorption and mist conditioning followed by a cyclonic separation. The units combine advantages of low water consumption, low initial cost and trouble-free operation even under the most severe industrial service.

Dust Collector

Aget Mfg. Co., Dept. MF, Adrian, Mich.



A new model Dustkop dust collector, to be used where greater dust storage capacity is necessary, is known as the 30NW50, and has an air handling capacity of 3600 cu. ft. of air per minute, with a static pressure of six inches of water. The new model is capable of collecting dust from practically any dust creating machine or operation, especially where the dust volume runs to rather high bulk. The new collector eliminates the emptying of a regular dust bin by shovel, with the addition of two rubber caster, roller dust cans that are connected to the collector by an all metal diversion Y, for simplified emptying and maintenance. The unit is available as a recirculating air unit, or with attachments for outside exhaust where state codes, or the nature of the type of dust prohibits recirculation of the air within the plant. New clamp-on lids and Y connection are self suspending for roller can removal and dumping operation.

Flooring Material

Naugatuck Chem. Div., United States Rubber Co., Dept. MF, Rockefeller Center, New York 20, N. Y.

A new concrete-type flooring material that "gives" without cracking under heavy loads, dampens shock and noise, resists alkalies and mild acids,

is waterproof and has a non-slip quality, is a combination of liquid rubber and a special cement powder and is called Laticrete. The rubber content makes it so flexible when hard, that a long, thin slab can be bent into a circle by hand. The rubber also gives the cured mix "bounce" and a tight bond that makes it resist breakdown under heavy use. Test patches in factories show virtually no wear after two years of high-volume traffic.

The concrete-rubber mix is a surface coating and can be used for repair work or in new installations. It has good adhesion to concrete, metal and even glass. A quarter-inch layer, the suggested thickness, will support heavy loads such as fork lift trucks when put down over a hard base.

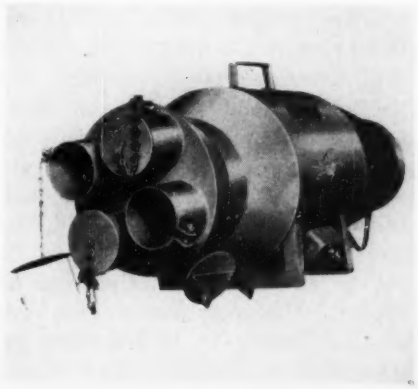
The material comes in two parts, the powder and a liquid rubber, and is prepared like regular concrete. Standard masonry equipment is used both to mix and apply it. One of the few requirements in using it, is that it must be applied to a clean surface. Dust, oil and other foreign matter prevent a bond to the base material. Any acid on the surface to be coated must be neutralized before putting down the surfacing material. Otherwise it is handled like concrete or mortar and can be trowelled or buffed to give a smooth surface.

The light gray mix can be pigmented in a wide range of colors. Its cost is above concrete, but below acid-proof brick or tile. Both the liquid rubber and special cement powder are being supplied by the company.

Exhauster-Blower

Chelsea Fan & Blower Co., Inc., Dept. MF, Plainfield, N. J.

Flexible and powerful ventilation for one or several separate confined working spaces is provided by the portable Type OPJ 'Octopus Junior'



MARCHANT GOES AUTOMATIC IN PLATING

Udylite Automatic Plating Machine Brings Big Savings to Calculator Maker

The same benefits Marchant Calculators, Inc., enjoy from the installation of a Udylite automatic plating machine can be yours—and for only a modest capital investment.

Better process control, reduction in operating and maintenance costs and improved work quality are the result of Marchant's installation of a Udylite Junior Full Automatic. In addition, they are now experiencing better ventilation, better and safer working conditions, manufacturing control with built-in instrumentation, greatly reduced materials handling and a minimum of rejects.

When the time came to install new plating facilities for their expanding business, Marchant naturally turned to Udylite. After a study of the Marchant problem Udylite engineers recommended the Udylite Junior with an automatic load and unload conveyor for the cadmium plating to fine tolerances of the many parts of the Marchant Calculator.

And so, another business friendship has been formed.

We at Udylite can help you improve quality and save money in your metal finishing operations. For quick response fill in the coupon below.

WORLD'S LARGEST PLATING SUPPLIER

We are interested in Udylite Automatic Equipment for our metal finishing operations. Have your salesman call.

NAME

COMPANY

STREET ZONE

CITY STATE

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

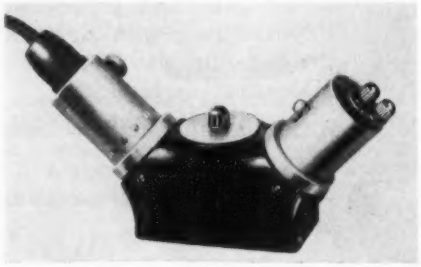
Just what you want—
FAST DEPOSITS
UNIFORM DEPOSITS
HUSSEY
Plating Quality
COPPER
ANODES
Genuine plating quality anodes manufactured to exacting specifications to assure fast, uniform deposit. Immediate delivery.
C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES, PITTSBURGH 19, PA.
7 Convenient Warehouses to serve you promptly!
PITTSBURGH . 2850 Second Ave.
CHICAGO . . . . 3900 N. Elston Ave.
CLEVELAND . . 5318 St. Clair Ave.
ST. LOUIS . . . . 1620 Delmar Blvd.
NEW YORK . . . . . 140 Sixth Ave.
PHILADELPHIA. 1632 Fairmount Ave.
CINCINNATI . . . . 424 Commercial Sq.

exhauster and blower. Lightweight, the blower can be placed or hung in any convenient location between the working area and fresh air, then connected with flexible hose to areas needing ventilation. Powered with a newly designed blower and a ¾ h.p. heavy duty totally enclosed ball bearing motor, it will operate in any position, and can be converted from exhausting to a fresh air supplier simply by changing the position of the nozzle adapter.

The unit is furnished with 4-3″ adapters, 3-4″ adapters or a single 8″ adapter, and will operate effectively with up to 50′ of flexible hose. Caps are provided for closing nozzles not in use.

Glossmeter

Epic, Inc., Dept. MF, 154 Nassau St., New York 38, N. Y.

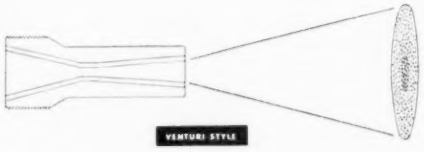


The Dr. Lange Glossmeter is an inexpensive photoelectric instrument to measure gloss and polish of metals, enamel, lacquers, etc.

The instrument operates at 110 volts, 60 cycles. Terminals are provided for connection to any sensitive pointer micro-ammeter or galvanometer for reading of the photoelectric current, which is directly proportional to the measured gloss. Weight is 22 oz.

Sandblast Nozzles

Clementina Ltd., Dept. MF, 2277 Jerrold Ave., San Francisco, Cal.



New Clemco venturi nozzles, for all sandblast machines are claimed to permit users to cut operating costs 20 to 40% by higher square foot blasting per hour. The nozzles will fit all sandblast units now in use.

The venturi design is stated to produce higher impact and a larger pattern. Uniform impact, without the large fringe areas, permits the blaster to clean a surface faster and cleaner and do more work with the same amount of abrasive and air.

They are available in short lengths for close work or in longer lengths for hard to clean surfaces and all orifices sizes from $\frac{3}{16}$″ to ¾″. The tungsten carbide lining insures long life.

Anodized Aluminum Tester

Sunshine Scientific Instrument, Dept. MF, 1810 Grant Ave., Philadelphia 15, Pa.

The anodized aluminum tester safely and accurately determines the effectiveness with which an anodized coating has been applied. The instrument tests chromic- and sulphuric-acid-type coatings, and is designed to meet ASTM-B110 specifications. It operates on the principle that the 60-cycle breakdown voltage is proportional to the coating type and thickness. It is supplied with three ranges. The 0-20 volt range tests the chromic-acid-type coatings, and the 0 to 100 and 0 to 600 volt ranges test the sulphuric-acid-type coatings. A unique current-limiting feature protects the operator from harmful electric shock. The tester is also useful for measuring other coatings where the voltage breakdown principle can be applied. The manufacturer has prepared a Catalog No. 12 describing this instrument in detail.

Vapor Degreasing Solvent

Tect, Inc., Dept. MF, Dumont, N. J.

Reduction in the price of Vythene and stabilization of the solvent for solvent vapor degreasing of all metals were simultaneously announced recently.

Effective August 15th, in 16 delivery areas, the solvent was priced at $1.73 a gallon in 55 gallon drums, a saving of 6c a gallon. Modifications of the chemical are now also available at prices as low as $1.18 a gallon.

The material is a stabilized 1, 1, 1-trichloroethane which will withstand refluxing with aluminum in all stages of distillation, boiling, vapor, and condensate without any breakdown of the solvent or corrosion of the aluminum even after refluxing has been continued for periods in excess of 2,000 hours.

BUSINESS ITEMS

Spanish Edition of Correspondence Course

An agreement recently signed between the *Instituto Electroquimico, S. A.*, 56 Corcega, Barcelona, and the *Joseph B. Kushner Electroplating School*, 115 Broad St., Stroudsburg, Pa. will make available to the Spanish electroplating industry a Spanish version of Electroplating Know How, the home study course in modern electroplating. A translation of the course is now in preparation and will be available in the next few months. The Spanish course will be given by the Instituto Electroquimico under the personal supervision of *Prof. M. Terol*, well known Spanish electrochemist and metallurgist. The scholastic records of the Spanish students will be kept both in the U. S. and Spain and diplomas will be awarded as in the United States to Spanish students completing the course.

Trane Company Announces New Field Sales Appointments

Three new appointments to field sales positions have been announced by *The Trane Company*.

S. Rowe Hill, manager of the sales office at Little Rock, Ark., for the past three years, has been appointed manager of the Oklahoma City sales office. Hill, a graduate of the University of Oklahoma, joined the firm in 1948 as a member of the student training program. He has subsequently been associated with company offices in Tulsa, Memphis and Little Rock. He is a veteran of 39 months of military service, having served as a captain in the Corps of Engineers.

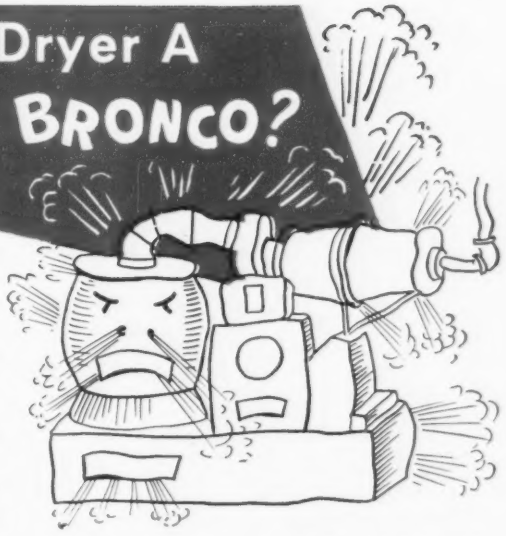
Banks W. Clark, formerly manager of the sales office in Oklahoma City, has been appointed manager of the company's Dallas sales office. Clark succeeds *A. J. Hackl*, who has recently joined the refrigeration department at the home office in La Crosse.

Clark joined the company in 1950 as a trainee in the student program. He was sent to the Greensboro, N. C. office as a sales engineer, and later assigned to the Oklahoma City position. A native of North Carolina, Clark was graduated from Duke University with a Bachelor of Science degree in mechanical engineering.

Jack Rule, an engineer with ten years of previous sales experience, will become manager of the Little Rock sales office September 1. Rule attended the University of Arkansas and received his degree in mechanical engineering from the University of Oklahoma. He is a veteran of three years of service in the U. S. Navy.

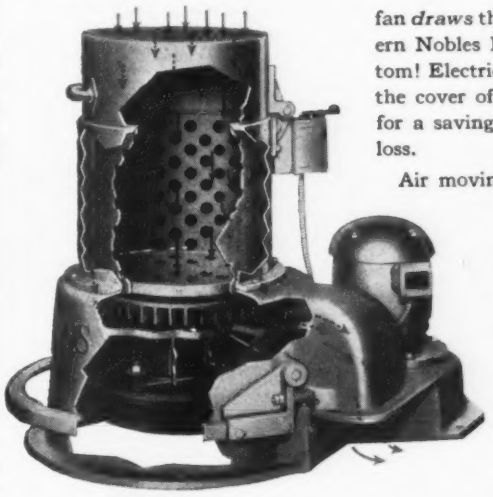
All three men are members of the American Society of Heating and Air Conditioning Engineers.

Is Your Dryer A BUCKING BRONCO?



In order for a centrifugal dryer to stay put it should be heavy. That's why the modern Nobles Dryer is about twice the weight of most dryers. Extra weight is one of the reasons for its stability, its freedom from vibration, its smooth operation, and long trouble-free life.

It's all new in design and principle. A powerful suction fan *draws* the air completely through this modern Nobles Dryer and exhausts it at the bottom! Electric or steam heaters are mounted in the cover of this machine of advanced design for a saving of space and elimination of heat loss.



Air moving equipment isn't an extra. The powerful suction fan is an integral design feature of each machine. A brake pedal extending around the entire work area controls an internal, expanding hydraulic brake for quick, smooth stops.

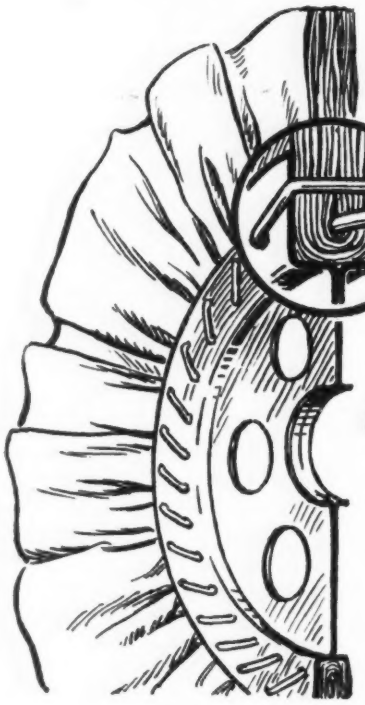
Why not take the first step now toward modern quick drying and lowest costs?

NOBLES ENGINEERING & MANUFACTURING CO.

[illegible] EAST SEVENTH STREET ST. PAUL 6, MINNESOTA

Write Today for the FREE NOBLES DRYER BROCHURE

BARKERMATIC



METAL CENTER BIAS TYPE BUFF

HIGH TENSILE STEEL STAPLE

WELDED STEEL RETAINING RING

STEEL PLATE ON EACH SIDE

STRONGER BY ACTUAL TEST

Yes, up to twice as strong!

Actual tests by an independent testing laboratory proved that the Barkermatic held together under almost double the load required to pull other buffs apart.

Barkermatics in production buffing are doing jobs with safety where other buffs have ripped loose from the center.

WHY ARE BARKERMATICS STRONGER?

The Barkermatic does not rely on small teeth part way through the cloth. In the Barkermatic the cloth is secured to the center by a solid fastening that goes completely through steel plates on both sides of the cloth. This type fastening cannot bend out and release the cloth while running at high speeds. Extra protection is provided by a steel retaining ring in the center assembly. The Barkermatic ***cannot*** fly apart.

AVAILABLE IN ALL SPECIFICATIONS

WRITE FOR OUR COMPLETE CATALOG.

PROMPT SHIPMENT ON MAIL ORDERS.

For added safety "USE BARKERMATICS"

BARKER BROTHERS INC.

ESTABLISHED 1911

1660 Summerfield Street Brooklyn 27, N. Y.

James P. McNally

Bart Manufacturing Corporation Appoints McNally Sales Manager

Ray N. Griffin, vice-president of *Bart Mfg. Corp.*, Belleville, N. J., pioneer producers of anti-corrosive nickel plated steel pipes, fittings and sheets, announces the appointment of *James P. McNally* as sales manager. Mr. McNally has been with the company for the past year. An alumnus of Syracuse University and the University of Wisconsin, with a major in Metallurgical Engineering, he has also served in the capacity of metallurgical technical adviser on the forming and fabrication of nickel plated steel, and has initiated and directed the firm's welding research program.

Mr. McNally has also been charged with the responsibility of coordinating various aspects of the recently announced exclusive sales agreement with Colorado Fuel and Iron covering the distribution of Bart Lectro-Clad steel sheets, and will continue to serve as liaison between managements of both companies.

Previously affiliated with the Carrier Corp. as production metallurgist, Mr. McNally did extensive work in the solution of metallurgical problems in the manufacture of air conditioning equipment, Atomic Energy Commission axial flow compressors, Air Force jet engines, and Army tank hulls. He is a member of the American Ordnance Ass'n.; American Society for Testing Materials; American Society for Metals; American Welding Society; American Electroplaters' Society. He has also served on the Conservation of Nickel Committee, Department of Commerce, B. S. D. A., Washington, D. C.

Diamond Alkali Announces Puerto Rico Subsidiary

Formation of *Diamond Chemicals of Puerto Rico, Inc.* has been announced by *Diamond Alkali Co.*, Cleveland, Ohio. The new firm will operate as a subsidiary with *Miles H. Fairbank, Inc.*, of Puerto Rico, holding a minority interest.

The subsidiary's plant will be located at 178 Elzaburu St., Hato Rey, a suburb of San Juan, capital city. The existing structure was formerly owned and used solely by Fairbank.

Scheduled to begin operations in approximately 30 days, the company will formulate an expanding line of detergents and cleaning compounds. First product to be manufactured and marketed will be a sodium hypochlorite bleach. All present and future products will be distributed and sold under the subsidiary's own brand names.

The corporation held its organizational meeting recently in New York when the following officers were elected:

S. S. Savage, chairman of the board; *Miles H. Fairbank*, president; *J. H. Montgomery*, vice-president; *D. S. Carmichael*, secretary, and *W. A. Crichley*, treasurer.

Mr. Savage is also president of Diamond Alkali Inter-American Corp. and Diamond Alkali International,

Inc., Diamond's export subsidiaries.

Since 1949, Mr. Fairbanks, who manages the firm that bears his name, has been and will continue to be, Diamond's Puerto Rican distributor and sales representative.

Messrs. Carmichael and Crichley are secretary and controller, respectively, of Diamond Alkali.

Seymour to Ship Chemicals in Four Bottle Pack

The bulky, hard-to-handle carboys normally used for storing and shipping bright nickel plating solutions have been obsoleted at *The Seymour Mfg. Co. Replacing* the old five-gallon glass behemoths is a new, fiberboard carton containing four individual one-gallon bottles. Unlike the old containers, the new units are non-returnable.

Since the cartons are only 14" square and 12" high, they are easily stacked in a small fraction of the space required for the big, wooden framed glass jugs. Furthermore, the one-gallon bottles are a distinct convenience in handling small quantities of the plating solutions.

The new packaging method has not entirely replaced the traditional five-gallon bottle at Seymour. Large volume users will continue to be supplied in the old manner, but the new carton will be used whenever possible.

Demonstration Unit Brings Story of Tygon Hot Spray Paint to Plants

A novel method of demonstrating the film building effectiveness of Tygon "ATD" hot spray paint is being employed by *The U. S. Stoneware Co.*, Akron, Ohio. A station wagon fully equipped with spray and paint heating equipment, is touring the industrial areas where corrosion problems are unusually severe. In key plants throughout these areas demonstrations are arranged to show corrosion engineers and maintenance heads how the material can build a film thickness of 8-10 mils in a single application.

Sel-Rex

Precious Metals for Plating

Pioneers In
The Development of
Modern Precious Metal Plating Processes

Outstanding developments by Sel-Rex in precious metals for plating have resulted in better quality at less cost for both decorative and industrial platers. Superior engineering skill and long experience in the plating field make Sel-Rex your best choice for all precious metal plating needs.

Sel-Rex **BRIGHT GOLD PROCESS** produces pore-free "mirror bright" deposits regardless of thickness. Eliminates need for scratch brushing or buffing. Gives excellent metal distribution and deposit is twice the hardness of conventional gold. Ideally suited for specification thickness in barrel or still plating.

Sel-Rex **BRIGHT RHODIUM SOLUTIONS** provide a brilliant, durable deposit that will withstand severe abasion. The chemically stable solution is ideal for specification plating of protective coatings that will not corrode or tarnish in any atmosphere.

Sel-Rex **SILVER SOL-U-SALT** (Potassium Silver Cyanide) in pure crystalline form is completely soluble in water. Eliminates old fashioned mixing, calculating or filtering. Eliminates hazard of airborne dust—no insoluble particles in the bath to cause rough deposits.

Consult our engineers on any precious metal problem. No obligation. Detailed literature available on request.

Dept. MF-9

SEL-REX PRECIOUS METALS, INC.

229 Main Street • Belleville 9, N. J.

Pioneers and developers of better gold, silver, nickel, copper, cadmium and rhodium salts and solutions.

Allied Research Expands Warehouse Program

Allied Reesarch Products, Inc., Baltimore manufacturers of the Iridite line of chromate conversion coatings for non-ferrous metals and ARP plating chemicals, has announced the establishment of warehouses in Cleveland, Ohio; Detroit, Mich.; and Chicago, Ill. The addition of these depots is part of the company's continuing program to locate warehouses in strategic industrial areas so that manufacturers in those areas can obtain shipments without delay and on a regularly scheduled basis.

Additional warehouse locations will be announced in the future.

G.E. Appoints Frederick T. Scott

The appointment of *Frederick T. Scott* as manager of marketing for *General Electric Co.'s* Industry Control Department in Schenectady, N. Y. was announced recently by *B. W. Mahoney*, general manager.

Mr. Scott succeeds *J. T. Bailey* who has been named manager of the company's Outdoor Lighting Department, Lynn, Mass.

With GE since 1936, Mr. Scott comes to his new assignment from Detroit where he had been manager-product sales, for Michigan User Industry Sales, Apparatus Sales Division.

2 Perma-Line ACES

SCIENTIFICALLY DEVELOPED, TIME TESTED, for High Resistance to CORROSION...

A Perma-Line

BRUSHING NEOPRENE

★ *A Low-Cost Maintenance Coating*

A reliable, long life, plant and equipment protective coating, highly resistant to corrosive fumes, oil, splash and weathering. It is easily applied, quick drying and can be used economically on new and old cleaned surfaces of metal, wood or concrete.

This tough, resilient, chemical resistant and high thickness coating has a good maintenance protection record on tank exteriors, ducts, structural steel, and general plant equipment, floors, stairways, etc., when applied in 3 coats at a unit coat thickness of 2 to 3 mils. Available in black or light gray.

A Perma-Line

No. 124

ACID-RESISTANT PAINT

★ *APPLY WITH BRUSH OR SPRAY*

This non-contaminating, easy to keep clean, synthetic resin base, solution type coating has gained wide acceptance — where ordinary paints corrode from acid and alkali fumes and spillage. Used by chemical, pickling, petroleum, plating, food and beverage plants, etc. Easily applied by brush or spray to wall surfaces, structural work, machinery, exterior surfaces of hoods, ducts and processing equipment. Needs no primer, 2 coats generally give complete coverage. Available in green, white, gray and black.

(Not recommended as inside membrane lining for acid storage, plating or pickling tanks or as a floor finish).

PERMA-LINE QUALITY PRODUCTS COMBAT CORROSION IN MANY INDUSTRIES

Perma-Line corrosion specialists are experienced in helping various industries successfully combat their particular corrosion problems, and in planning new installations.

Write us today for information or free literature regarding your specific corrosion problem.

PERMA-LINE
RUBBER PRODUCTS CORPORATION
1753 North Winnebago Avenue
Chicago 47, Illinois

From left to right, Mr. Arthur Grayson, President; R. O. Braaten, Project Engineer; and John Byrne, receive the $100 Almco Supersheen award for total dollar savings on finishing costs.

to over $124,000. annually over the previous deburring method. This was accomplished by the installation of one Supersheen Fixture Barrel, used for deburring compressor rotor discs for pet aircraft.

Not only does the barrel finishing meet rigid Air Force specifications on the break-edges, but deburring time has been cut from 18 hours to 4 hours per disc, increasing production 450 percent.

As winner of the quarterly 100 dollar award, Le Roy is eligible for the 250 dollar annual award which is presented to the company making the greatest total dollar saving over the 12 month period.

The new contest starts Sept. 11 and ends Dec. 31. It has been arranged so that companies of every size will have a fair chance to compete; a 100 dollar award will be given for the company reporting the greatest percentage of saving from barrel finishing a part as compared to former methods. There also is an annual 250 dollar award for this division.

Also, each contestant who returns a completed entry blank will receive an attractive carry-type food and drink cooler. Awards are made either in the name of the company or the finishing personnel involved.

Entry blanks for the new contest period can be obtained by writing Almco, Dept. MF, Albert Lea, Minn.

Diesel Chemical Co. Moves

The Diesel Chemical Co. is pleased to announce the removal of their offices and plant to new and larger quarters at 578 Carroll St., Brooklyn, N. Y. The telephone number remains MAin 2-0703.

He joined the company in 1936 and moved from the engineers' test program to the Switchgear Division in 1937. He was appointed switchgear specialist in the Detroit office in 1941 and in 1942 left for service as an ensign in the U. S. Navy. When released in 1945 as a lieutenant he returned to the Detroit office of GE as a sales engineer.

He was in charge of the Steel, Chemical and Large User Section, Apparatus Sales Division, from 1952 to 1953 when he was named manager-product sales, for the Michigan district of the division.

Mr. Scott is a registered professional engineer and a member of several engineering organizations, including Tau Beta Pi, the Engineering Society of Detroit, Association of Iron and Steel Engineers, Industrial Electrical Engineering Society and Theta Tau fraternity.

Born in Rose Hill, North Carolina, he studied at both North Carolina State College and Duke University. The Scotts have three children, Fred Jr., Stuart and Barbara Jean.

Supersheen Barrel Finishing Award Won By New York Aircraft Parts Manufacturer

Winner of the first *Supersheen Award* for the largest total dollar savings with Almco barrel finishing equipment is the *Le Roy Machine Company*, Le Roy, N. Y.

Savings reported by Le Roy amount

Udylite Expands

Leon K. Lindahl, chairman of the board of directors of the *Udylite Corporation*, announces an expansion and new building program. The new building is being erected on the 23 acres on which all Udylite Detroit facilities will be located in the near future. The offices and laboratories of the *Udylite Research Corp.*, shown on the drawing, are already on this site in front of the new factory. The future buildings including customer laboratories building and the administration building will be placed in front of the research building.

The factory building will have a manufacturing area of 160,000 square feet with a factory office area of 8,000 square feet. One third of the manufacturing area, approximately 50,000 square feet, is provided with 30 feet head room to take care of the increasing height of company built equipment. The building will be constructed of a steel frame of columns, trusses and beams with the exterior walls of masonry, sash and aluminum corrugated panels. The building will be served with a railroad siding with two spurs into the building through rolling steel curtain doors. Both receiving and shipping operations can be handled by rail. Motor freight can be received and dispatched from a six position truck well completely enclosed and protected by rolling steel curtain doors. Adequate parking facilities are provided immediately for 250 cars with a plan for future parking of 500 additional cars.

The firm also has a new New York office and warehouse in the process of construction. The new warehouse will double the present capacity and provide the much needed additional office space. The building will include new customer service laboratories and new show room. In addition to the two loading docks, the New York warehouse will have a pick up dock for customer convenience. The new location is in Long Island City, about a mile and a half from the present location.

The Chicago office also has a new warehouse and office under construction. The new location will give the Chicago district more than twice the present floor space. It also will have improved offices and customer service laboratories. The new location is in west side Chicago.

It is expected that these constructions will be completed and that the new buildings will be occupied by January 1st, 1956.

George W. Taylor to The Permutit Company

The Permutit Company, New York manufacturers of ion exchangers and

LOW TOXICITY

VYTHENE™ MAKES BIG NEWS!

NOW STABILIZED for

SOLVENT VAPOR DEGREASING

Add a new level of performance for Vythene™ . . the premium safety solvent without the premium price tag. Vythene™ — *Stabilized* 1,1,1-Trichloroethane—can now be used for solvent vapor degreasing of ALL METALS including ALUMINUM. Vythene™ — approximately 1/20th as toxic as Carbon Tetrachloride, 1/5th as toxic as Trichloroethylene—is versatile, efficient, and *safe*—the finest general-purpose solvent available today!

Also Unexcelled For Cold Degreasing of:

Aircraft parts and electronic equipment—electric motors —machinery—office equipment. Useful for plant maintenance—wax dispersion and removal. Accepted by America's leading industrial plants.

Write for complete data and name of local jobber.

Available from 16 distribution points throughout the United States.

TECT, INC.

DUMONT, NEW JERSEY

RIGHT FROM YOUR WATER TA P... GET YOUR

Demineralized Water

(WITHOUT REGENERATION)

at 2¢ — 4¢ per Gallon

The Enley PUP
Model 616

If you are a distilled water user, get demineralized water at a lower cost per gallon than can be obtained from any Unit of comparable size.

The Enley "PUP" — is constructed of high temperature Acrylic resin throughout and comes packed with ion-exchange material, carborundum porous stone and fiberglas screen filters.

MODEL #316 ENLEY "PUP" — produces 300 gallons of demineralized water from your water tap before resin is exhausted. Comes packed with 3 pounds of ion-exchange material. COMPLETE **$49.95**

MODEL #616 ENLEY "PUP" — produces 900 gallons. Comes packed with 10 lbs. of ion-exchange material. **Special Feature** — ion-exchange material can be regenerated in the Unit—cost can be as low as 1¢ per gallon. COMPLETE **$99.95**

Other units available of larger resin capacity at comparable prices. Write for full details.

CHART BELOW EXPLAINING COST PER GALLON

mineral content parts per million (as $CaCO_3$)	output-Gallons per refill (1 pound of material)	cost per gallon per lb. of material — in cents
50	210	1.2c
100	102.5	2.4c
150	69	3.6c

based on material costing $3.25 per lb. and credit of 75¢ per lb. for exhausted material returned to Enley Products Inc. NET COST OF MATERIAL $2.50 per lb.

Based on raw water containing 100 ppm mineral content as $CaCO_3$. Prices f.o.b. Brooklyn, N. Y.

FULLY GUARANTEED

We Guarantee our products to perform as advertised or we refund your money.

FOR PROMPT DELIVERY ORDER NOW!

ENLEY PRODUCTS, Inc.

1236 BROADWAY (DEPT. MF-9) BROOKLYN 21, N. Y.

water conditioning apparatus for commercial and industrial applications, has announced the appointment of *George W. Taylor* as chemical research engineer in the Special Applications Department. In his capacity, he will devote full time to the application of ion exchangers and equipment in fields other than water conditioning.

Taylor received his Bachelor's degree in Chemical Engineering from Princeton University in 1948 and his Master's degree from Lehigh University in 1951. Following receipt of the Master's degree, he was employed at the Johns-Manville Research Center in the research and development of friction materials. He is a member of the American Chemical Society and American Institute of Chemical Engineers.

George W. Taylor

MacDermid Appoints Krentel

Stanley S. Krentel was recently elected vice-president and sales manager of *MacDermid Western Inc.*, Ferndale, Mich., a wholly-owned subsidiary of *MacDermid Inc.*, of Waterbury, Conn.

Stanley S. Krentel

Mr. Kentel is a chemical engineering graduate of Michigan State University and has been with the firm for 10 years, most recently as manager of the Michigan sales territory.

Northwest Chemical Expands Facilities

Northwest Chemical Co., 9310 Roselawn, Detroit 4, Mich., nationally prominent manufacturer of chemical cleaners, has completed a new addition to their present facilities according to an announcement by *H. J. McCracken*, president. The new addition doubles both the warehousing and finished goods storage areas.

Vanton Pump Appointments

The appointment of *Stuart F. Cooper* as sales engineer in the Metropolitan District was announced by *Vanton Pump & Equip. Corp.*, Hillside, N. J. Mr. Cooper will be responsible for sales and service in northern New Jersey, New York City, Long Island and Westchester.

Since joining the company Mr. Cooper has been engaged in an extensive technical and service training program designed to aid in the solution of difficult pumping problems. He is a graduate of Newark Academy

and received his B.A. degree from Bowdoin College in 1953. He lives at 7 Robert Drive, Chatham Township, N. J. with his wife and daughter.

The appointment of *Backus & Spencer*, Cleveland, Ohio, as sales representatives in the Northern Ohio Territory, was also announced. With almost a quarter century of experience in servicing chemical and allied process industries, Backus & Spencer salesmen, all of whom are graduate chemical and mechanical engineers, should provide valuable aid in the solution of difficult pumping problems.

Stuart F. Cooper

John F. Siefen Resigns

John F. Siefen, president of the *J. J. Siefen Co.* has resigned and is no longer connected with the company as of July 20th, 1955.

Mrs. I. E. Siefen announces the company standards and policies will not change and business will be conducted as before.

R. O. Hull & Co. Appoints Parker

Robert G. Parker has joined *R. O. Hull & Co., Inc.* of Cleveland, Ohio, in the position of technical service representative. He will work out of the New Haven, Conn., office of *Enthone, Inc.*, which firm is the distributor for Rohco products in New England and eastern states.

Mr. Parker is well known around the Bridgeport area, having spent the past twelve years there as plating foreman at Casco Products Co. He attended the Bridgeport Engineering Institute and the University of Bridgeport. Currently, Mr. Parker holds the office of Secretary, Bridgeport Branch, A.E.S.

Robert G. Parker

Behr-Manning Appoints Three Sales Executives

Appointments of three men to executive posts in the sales organization of the *Behr-Manning Division* of *Norton Company* have been announced at Troy, N. Y., by *Henry R. Merrill*, general sales manager.

Thomas Trowbridge of Brunswick Hills, Troy, a veteran engineer in the coated abrasives field, was named assistant general sales manager. *William J. Bennett* of Albany became sales manager for the company's eastern region and *Victor F. Perreault*, also of Albany, was appointed industrial trades manager.

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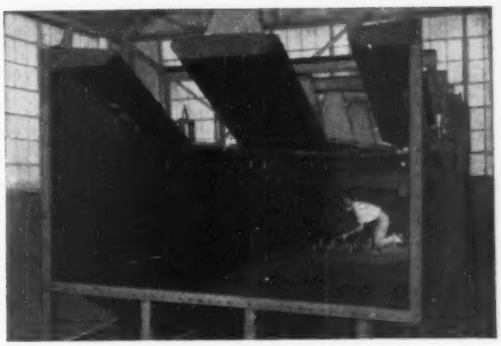

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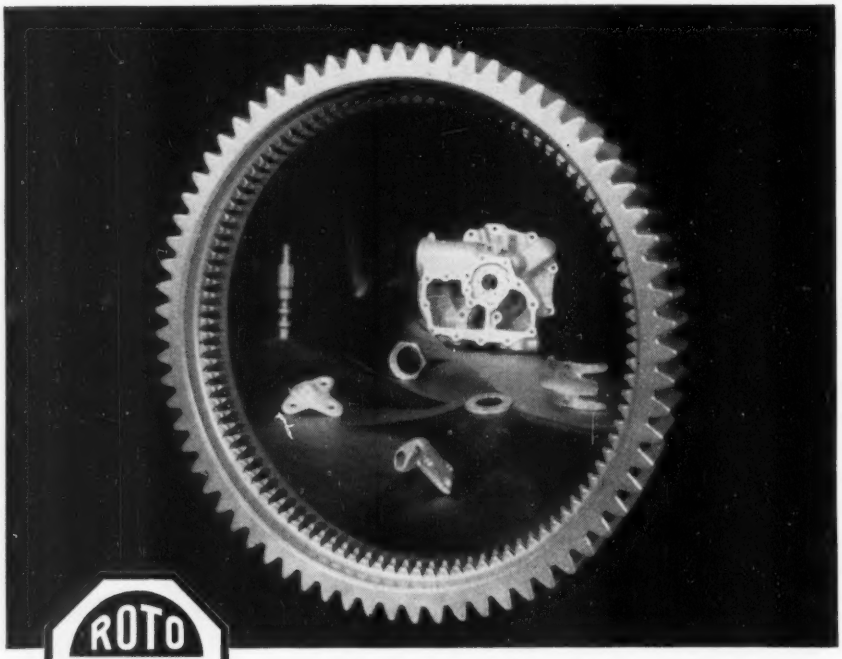

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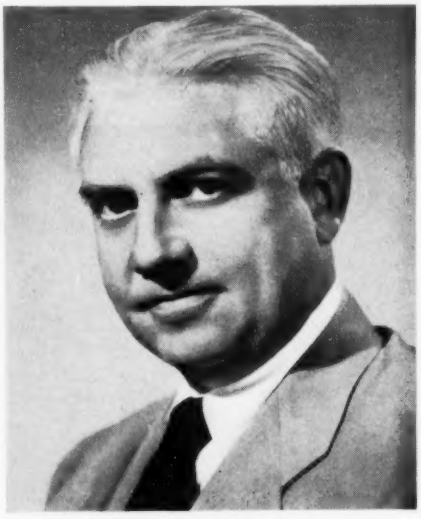
Thomas Trowbridge

Trowbridge, a native of Montclair, N. J., studied sales and sales management at the New York University School of Business Administration. He joined the sales department in 1922 and served as a field engineer in the company's Detroit division. He was sales manager of Durex Abrasives, Ltd. in Birmingham, Eng., in 1930 and 1931, returned to Behr-Manning as a field man in New Jersey in 1932 and, after two years as product engineer, became sales manager of the New York and Philadelphia divisions in 1935. He was made assistant manager of the product engineering department in 1945, and became its manager in 1947. He has been sales manager of the company's eastern region for the past six years.

Bennett, born in Troy, was graduated from Dartmouth College in 1932,



William J. Bennett

studied personnel administration at New York University and has been employed by the company since 1939, working successively as salesman, product engineer, Detroit division sales manager, manager of product engineering and, since early last year, industrial trades manager.

Perreault, also a native of Troy, studied economics at St. Michael's College in Winooski, Vt., and economics and law at the University of Washington. His work with the company started in the sales department in 1944. He served as field engineer, later as sales manager of the Buffalo division and in 1951 was appointed industrial sales manager for the Buffalo and Pittsburgh divisions. His appointment as industrial trades manager was prefaced by a brief period on special assignment at Troy.

Victor F. Perreault

Appointments Announced by Udylite

L. E. Drury

L. V. Nagle, executive vice-president of the *Udylite Corporation*, has announced the appointments in the *Udylite Division* as follows:

L. Eugene Drury has been named facilities manager in charge of supplies business, maintenance of buildings and equipment, supervision of new buildings and additions and supervision of transportation including truck and car fleets in the Traffic Department. Mr. Drury has been employed continuously by the firm since 1929 in various factory supervision capacities.

William J. Blashill has been named manager of manufacturing with the responsibility of manufacturing, quality control and delivery of all equipment. Mr. Blashill is a graduate of the University of Detroit with a Bachelor of Science Degree in Mechanical Engineering. His past experience includes acting as a works manager for Atlas Enameling of St. Louis, as an engineering consultant with Stevenson Jordon and Harrison from their Cleveland office and production control with Vickers, Inc. of Detroit. Blashill joined Udylite in 1950 and served as an industrial engineer since that time.

W. J. Blashill

Louis J. Minbiole, Jr. has been appointed sales manager of the division. Mr. Minbiole has a Bachelor of Science Degree in Chemical Engineering from Wayne University and a Master of Science Degree also in Chemical

L. J. Minbiole, Jr.

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Engineering from Massachusetts Institute of Technology. Before coming to Udylite in 1946 he worked with Buick Motor as a research engineer devoting his time to all types of surface coatings. He served Udylite as the sales engineer until 1953 when he came into the Detroit office as assistant sales manager of the division. Mr. Minbiole is a past president of the Saginaw Valley Branch of the American Electroplaters' Society.

William C. Neumann to Permutit

The Permutit Company, New York, manufacturers of ion exchangers and water conditioning apparatus for commercial and industrial applications, has announced the appointment of *William C. Neumann* as chemical research engineer in the Special Applications Department.

Neumann is, at present, working toward his New York State Pofessional Engineer's license and received his Bachelor's degree in Chemical Engineering from New York University in 1952. Upon graduation, he was employed in the research and development department of Stein-Davies and Co., Long Island City. He is a member of the American Institute of Chemical Engineers and the National Guard.

William C. Neumann

Battelle Announces V.P. Appointments

Three vice-presidential appointments at *Battelle Memorial Institute*, Columbus, Ohio, were announced recently by *Dr. Clyde Williams*, Institute president and director.

Named were *Dr. B. D. Thomas*, *David C. Minton, Jr.*, and *John S. Crout*. All three have long been associate directors of the research organization, and, along with Dr. Williams, comprise the key policy-making and executive team in Battelle management.

New Ultrasonics Consultants

A comprehensive consulting service in all phases of ultrasonics for industrial and scientific programs of any scope has been inaugurated by *Vibro-Ceramics Corp.*, an affiliate of *Gulton Industries, Inc.*, of Metuchen, N. J., according to an announcement by *Dr. Leslie K. Gulton*, president.

The new consulting service was planned to meet the widespread needs of many industrial firms and technical researchers who wish to utilize the latest advances in ultrasonics, but who lack the specialized talents and equipment needed.

A staff of theoretical physicists and engineers headed by *Dr. Paul Oncley* has been assigned the responsibility for analyzing problems, procedures, and programs in cooperation with client needs, as well as designing and

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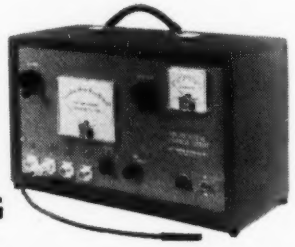

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Trane Opens New Coil Plant

The Trane Company of La Crosse, Wis., has announced the opening of its new 55,000 square foot coil manufacturing plant. The second new manufacturing area to be put into operation within a year, it consolidates all coil production operations into one location. The new plant is designed to increase present capacity 25-30 per cent.

Cost of the new plant, including $150,000 worth of new machinery and equipment, was $525,000. General contractor was Peter Nelson & Sons, of La Crosse.

Finishing the World's Largest Globe

The world's largest globe, designed and fabricated by the Bettinger Corporation of Waltham, Mass., receives its finishing touches. The globe, which is made of 584 pieces of porcelain enamel on steel, utilizes 21 colors to show the various political and geographical highlights of the earth. The

globe is located at the Babson Institute, Wellesley, Mass.

Promotions at Pfizer's Technical Service Department

Dr. C. L. Wrenshall, associate director of the Technical Service Dept. of *Chas. Pfizer & Co., Inc.* announces that *Dr. Robert C. Ottke*, has been appointed manager of the Development Section, and *John K. Shaw*, manager, Industrial Section.

Dr. Ottke has served with the Technical Service Department since the fall of 1953 after being transferred from chemical research and development where he had been engaged in steroid research work from 1951. He is a graduate of Yale University, having received his B.S. and Ph. D. degrees there in 1948 and 1950, respectively.

A graduate of Brooklyn Polytechnic Institute with a B.S. degree in chemical engineering, Shaw joined the company in 1950 as a laboratory assistant in the Pharmaceutical Research Department.

National Lead Names Prior

Harold D. Prior has been named manager of *National Lead Company's* Washington, D. C., office, succeeding *Carlton H. Rose*, who is now director of public relations for the company. Mr. Prior was graduated from Alfred University in 1935, majoring in ceramics. He was first employed by the company in the Niagara Falls laboratories of the Titanium Alloy manufacturing division in 1936. He has been district sales manager for the division's eastern territory since 1945.

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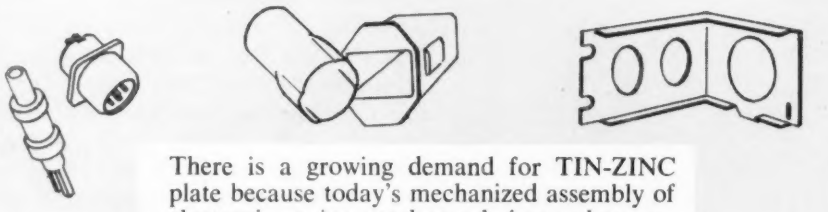

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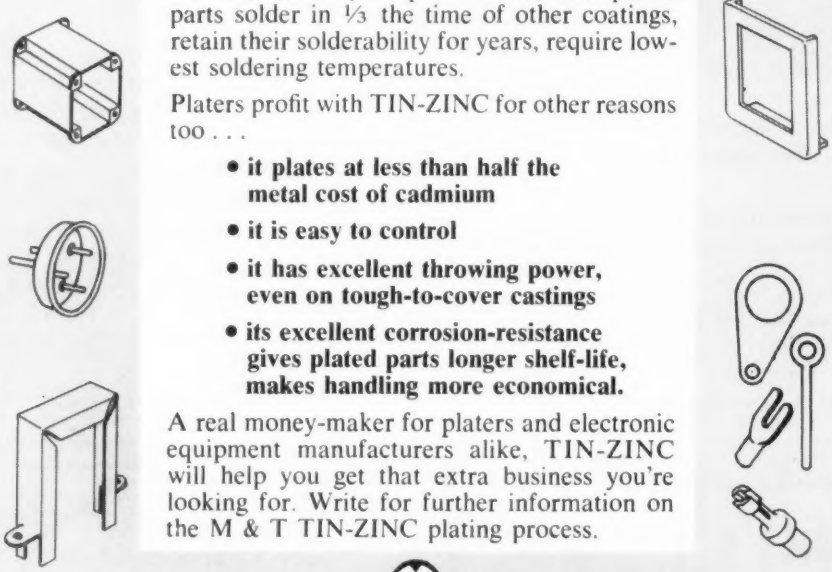

METAL & THERMIT CORPORATION
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Murrary and Klaussen Elected Chairman and President of Hooker Electrochemical

The board of directors of *Hooker Electrochemical Co.*, Niagara Falls, N. Y., announced the election on June 22 of *R. Lindley Murray* as chairman of the board. Mr. Murray succeeds *Edwin R. Bartlett* who resigned as board chairman to become chairman of the company's newly created finance committee, also announced at the time. At the same meeting, *Bjarne Klaussen*, formerly executive vice-president, was elected president of the company. Mr. Murray and Mr. Klaussen had been president and executive vice-president, respectively, since 1951.

Mr. Murray, born in San Francisco in 1892, came to the company in 1916 as a research chemical engineer. Having been graduated from Stanford University in 1913 with a bachelor of arts in chemistry, he was awarded the degree of chemical engineer from Stanford after a year of post graduate work. While at college, he was elected to Phil Beta Kappa and Sigma XI. In 1917 and 1918, he was national singles tennis champion.

At Hooker, he rose through various positions including manager of research, superintendent, chief engineer, director of development, vice-president in charge of development and research, and executive vice-president.

Mr. Murray is also president and director of Hooker Chemicals, Ltd., and of Marble-Nye Co., Worcester, Mass., both wholly-owned subsidiaries. He is vice-president and director of Hooker-Detrex, Inc., with plants at Tacoma, Wash., and Ashtabula, Ohio, and director of Chemical Salt Production Co. at Great Salt Lake, Utah, both jointly-owned subsidiaries. He is also a director of Detrex Corp. of Detroit.

Mr. Klaussen came to the company in 1916 as a research chemist directly from Norway, where he was born at Kristiansand in 1891. He was graduated from the University of Oslo as a chemical engineer in 1916. Although during one three year period he was manager of technical sales service, most of Mr. Klaussen's positions have been in the production side of the business. He became Niagara Falls works manager in 1941, a director in 1942, and vice-president in charge of production in 1947.

Mr. Klaussen is vice-president and director of Hooker Chemicals, Ltd., and of Marble-Nye Co. He is also a director of Hooker-Detrex, Inc., and Chemical Salt Production Co.

Changes at Hanlon-Gregory Galvanizing

In order to keep pace with the operations of the recently expanded *Hanlon-Gregory Galvanizing Co.* plant, *A. J. Diebold*, president, announces the following executive changes:

Vice-president *William H. McKenna* is named vice-president in charge of sales, and will direct all the firm's marketing operations.

Thomas Raymond Gregory, until recently manager of the Thomas Greg-

W. H. McKenna

T. R. Gregory

ory Galvanizing Works, Maspeth, N. Y. (no corporate connection with Hanlon-Gregory) has been named vice-president in charge of production.

Lawrence Nipp, formerly assistant superintendent and a veteran of 16 years with the company, has been made superintendent. Former superintendent *Henry Volker*, who has been with the company 30 years will continue with the firm in a consulting capacity.

Mr. Gregory, third generation of a galvanizing family and a nephew of the founder of Hanlon-Gregory, enters the firm with a background in galvanizing practice gained in experience since early youth in the Maspeth plant, founded by his grandfather and operated by his father.

He formally joined that company in 1947 after attending Hofstra College and serving in the Army. In his new position he will be charged with further developing the technical and operations end of the business.

Mr. McKenna, who attended the School of Engineering, Carnegie Tech., came with the company in 1936. In 1942 he was advanced to assistant to the president, and in 1951 to vice-president. A substantially enlarged sales program is planned under his direction.

Mido to Represent Rampe

Arthur Pine, president, *Mido Products*, Torrance, Calif., has announced that his firm has been appointed Southern California representative for the line of tumbling barrels, manufactured by *Rampe Mfg. Co.* of Cleveland, Ohio.

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Oldsmobile Automates Electroplating at New Multi-Million Bumper Plant

Oldsmobile's new multi-million dollar bumper bar plating installation at the company's Saginaw St. Plant in Lansing, Mich., whose giant copper, nickel and chromium plating machines were made by *Hanson-Van Winkle-Munning Co.*, is a conspicuous example of automation in the finishing field. For instance, automatic loading and unloading mechanisms were specified for the copper, nickel and chromium plating machines. While such equipment may have been designed and built originally as labor-savers, the mechanisms were practically a necessity here, since the company is loading racks that weigh, when full, close to 1,000 lbs., and at the rate of one every 163 sec.

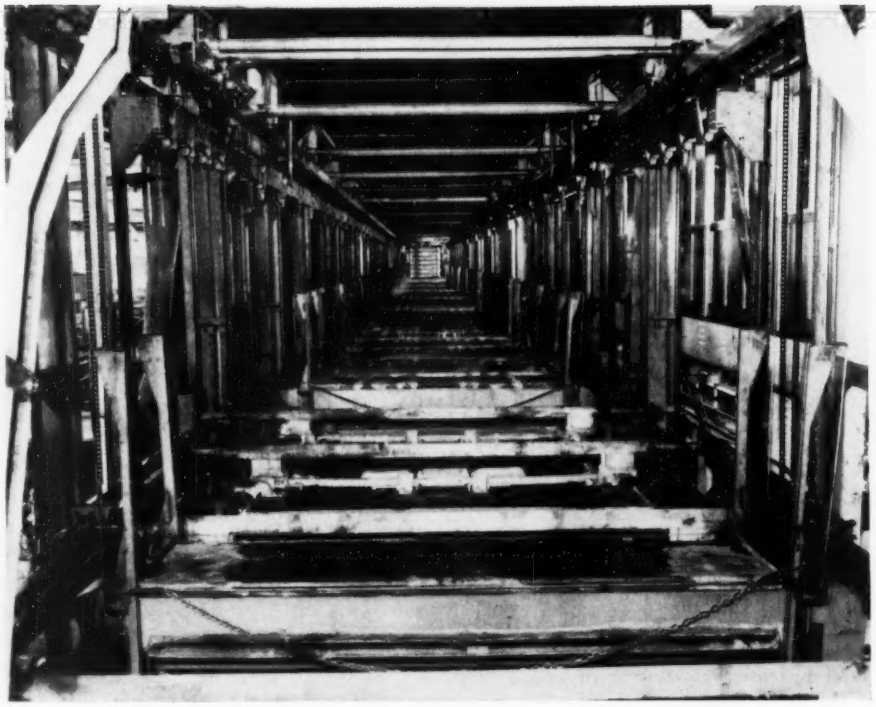

Figure 2. Copper plating line with elevator down, showing pretreatment baths. Note up-draft exhaust system.

Selective Cell-Type Plating

While Oldsmobile used all the automatic plating tools that were at its disposal, there was one that was not commercially available to the company at the time plans were being drawn. It involved fully automating cell-type plating.

In a cell-type operation, plating is carried on in many individual cells with racks stationary during a fixed time cycle. In conventional automatic plating, racks travel continuously or intermittently through a large tank. Cell-type plating is obviously more difficult of the two to make fully automatic and continuous. To do so, it is necessary that the plating section receive racks coming from pre-treatment tanks on a fixed time cycle, and deliver to after-treatment tanks on another established cycle.

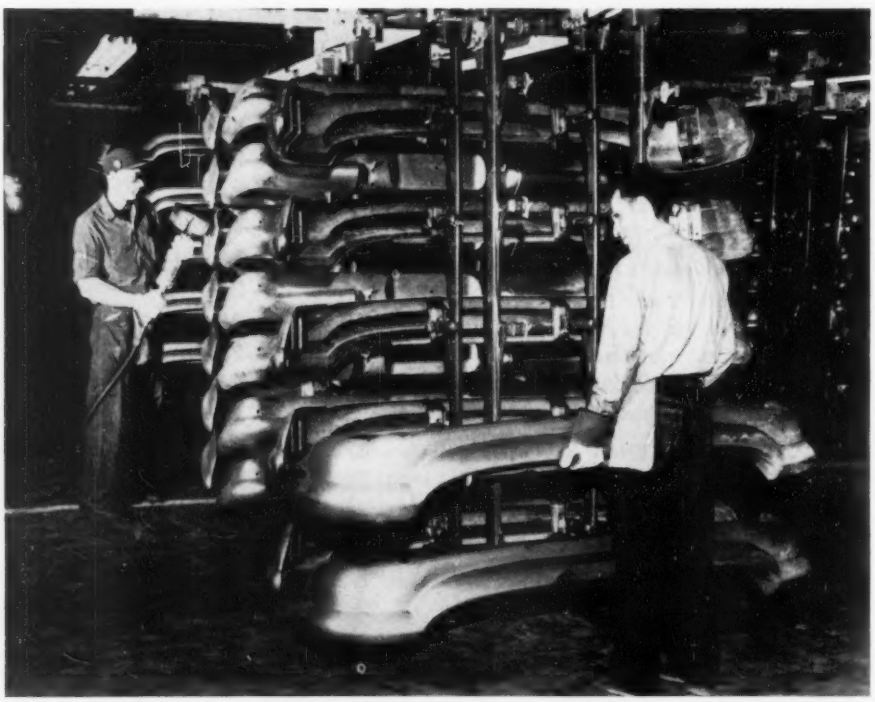

Figure 1. Loading racks prior to copper plating, worker in background is touching up rough spots with a hand buffing wheel. Worker in foreground is loading front bumpers on the plating rack. Note 10 bumpers to a rack. Other racks contain rear bumpers — 14 to a rack.

The operation has to be made selective in that racks to be plated would be deposited in an empty cell, and by-pass all other cells. Plated racks also would have to be picked up from a cell after a predetermined time, then by-pass other cells as they are delivered to the after-treatment tanks.

Why cell-type plating in the first place? The new wrap-around shape requires the use of conforming anodes to facilitate the even distribution of metal coating over the curved bar. This type of plating is carried out best in individual cells where anodes may be simply arranged around the sides of the cell to conform to the shape of the bumper bar.

Cell-type plating has advantages when bumper bars are racked horizontally. In its former system, Oldsmobile racked its bumpers vertically and ran the racks continually through a large plating bath. When the wrap-around shapes were specified, conforming anodes had to be placed on the top and bottom of the plating bath. This was far from an ideal arrangement as the anodes had to be bagged, and dirt and foreign material tended to settle on the bottom anodes.

How Oldsmobile Plates Bumpers Automatically

Flat steel is automatically polished, then after bumper bars are formed and brackets welded on them, units are inspected and given a final touch-

up with a hand polishing wheel, and subsequently loaded on a rack. The rack is conveyed to the copper plating machine by an auxiliary materials handling system.

Bumper bars are automatically loaded onto the plating conveyor, then given an alkali wash, cathodic cleaning, cold rinse, hot rinse, acid etch, cold rinse, another cold rinse, anodic cleaning, cold rinse, acid dip, cold rinse and a cathodic cyanide dip. Immersion in a cyanide copper strike bath and a reclaim rinse follow. Bars are then plated (0.0015″) in the cell-type copper plating baths. After that, they are put through a reclaim rinse bath and given a final rinsing. As racks come out of the hot rinse tank, they are automatically unloaded from the plating conveyor to the auxiliary conveyor.

Racks then pass on to the automatic buffing lines. There are two buffing lines: one for front bumpers, one for rear units. Carrying fixtures are directed to proper areas by adjusting a selector switch on the fixture. Bumper bars are buffed, then washed.

Nickel plating follows. Racks are automatically loaded on the nickel plating conveyor exactly as they were on the copper plating machine. Bumpers are cathodically cleaned, cold rinsed, twice in separate tanks, dipped in cathodic cyanide, given a flash coating of cyanide copper, cold rinsed, then immersed in a bright nickel bath. Plating (0.0008″) is accomplished in individual cells equipped with conforming anodes. A reclaim rinse, a cold rinse and a hot rinse follow the nickel plating.

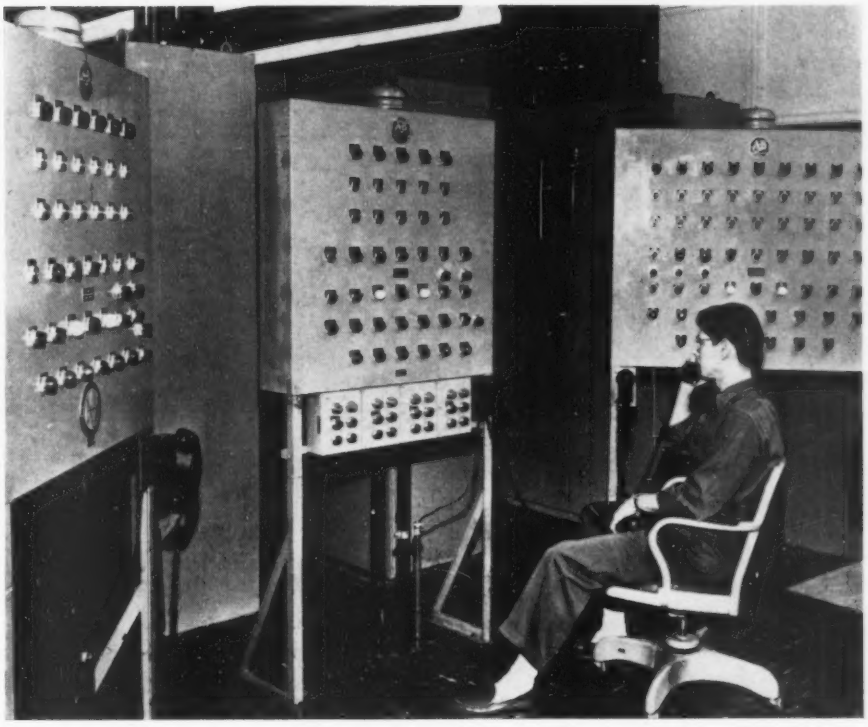

Figure 4. Main control room. All electrical controls for the conveyor systems are housed here. One operator mans this station, and is in communication with operators throughout the plating installation.

Bars are then reracked for chromium plating. Where 12 bumper bars were placed on a rack, 10 units are now hung. In the chromium plating operation, bars are automatically loaded, then cathodically cleaned, cold rinsed, immersed in a cathodic acid bath, cold rinsed and then warm rinsed. They are next immersed in one of three cells located in a 25-foot chromium plating tank. Two reclaim rinses, a cold rinse and a hot rinse follow.

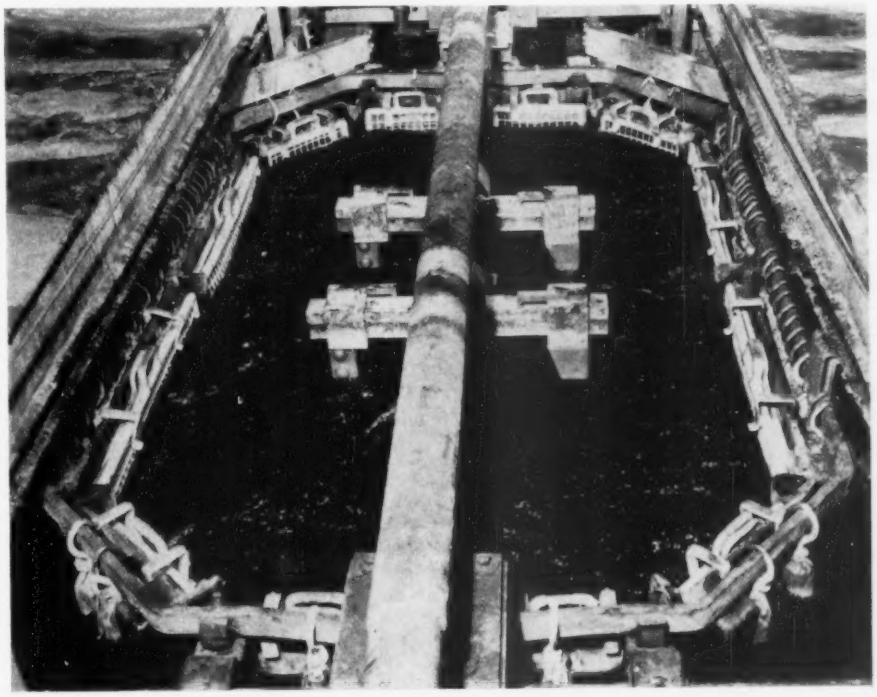

Figure 3. Plating a rack of bumpers in individual cells. Note anodes hung on sides of the cell to conform to the shape of the racked bumpers. The wrap-around shape of today's bumpers requires conforming anodes to give even plate distribution.

After chromium plating, bars are automatically unloaded, reracked and sent through a 550-degree stress relief oven, the trip taking 30 minutes. Heating is done to prevent hydrogen embrittlement; that is, to make the plating ductile and prevent future cracking.

Every electrified cell has its own generator. There are twenty-four 10,000-amp., 12-volt sets for the copper cell-plating operation.

There are ten 7500-amp., 15-volt sets for the ten nickel cells, two 15,000-amp., 12-volt sets for the 2 chromium cells. For each electrified cell in the pre-treatment cycles there is an individual set. These are mostly 7500 ampere, 9-volt, units although there is a 15,000 ampere unit on an acid etch and a 5,000 ampere on another electrified tank.

To get the production that it wanted,

Oldsmobile set up 24 plating cells on the copper line located in six tanks. The nickel line has 10; the chromium, 3. Each set of plating cells is served by a common elevator, but individual racks are lifted and lowered selectively by means of a solenoid-operated flipper mechanism. Plating takes about one hour for copper, 24 minutes for nickel, and 2½ minutes for chromium.

When the plating time is up, a rack is automatically picked up and conveyed to a reclaim rinse tank. A new rack load is then brought from the cleaning cycle and deposited into the empty plating cell where it remains stationary for the full plating cycle. Controlling the ascent and descent of the work carriers is the flipper mechanism at each cell.

Each machine consists of a precleaning, plating and rinsing section. The overall operation is so coordinated that the cleaning section delivers to the plating section and the plating section delivers to the rinsing section in accord with a predetermined time cycle.

A transfer mechanism does the loading and unloading. It consists basically of a pair of arms, pivoted at one end, that engages the cross-bar of the plating rack. In loading, the rack is carried from an auxiliary conveyor system fixture, a distance of about seven feet, to an empty work carrier on the plating conveyor. The unloading is entirely similar in operation.

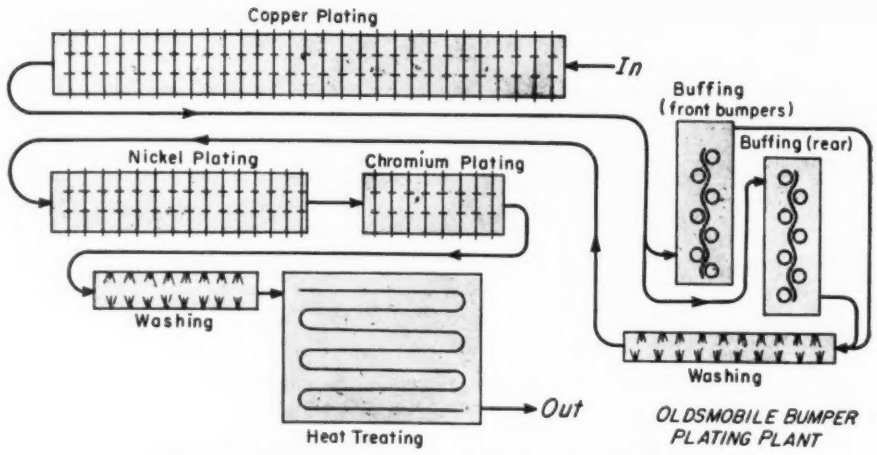

Figure 6. Schematic drawing of bumper plating installations.

Design Innovations in the Plating Machines

Because of the weight and size of the work load, the three special automatic plating conveyors, based on the standard elevator-type design, had to be built.

Each of three conveyors has separate hydraulically-operated elevator mechanisms for the three phases of the plating operation—pre-treatment, plating and rinsing. Racks of bars over the pre-treatment tanks are elevated, advanced & lowered simultaneously. The racks in the rinsing section are handled in the same manner. Racks for plating cells are individually and selectively handled.

Racks are advanced from the pre-treatment cycle to the cell-plating cycle while immersed in the final pre-treatment rinse bath. A transfer bar moves the carrier horizontally while it is in this tank until it is in a position to be picked up again. Transfer from plating cycle to rinsing cycle takes place conversely.

Special features of the plating machines include provisions for advanced pick-up and delayed set-down. For instance, during a rinse and acid etch in the pre-treatment phase of the copper-plating cycle, carriers are picked up early. This is done by a separately-actuated hydraulic mechanism. The operation is controlled by an adjustable timer located in the main control panel of the conveyor.

Delayed set-down is required during the cathodic etch in the chromium plating cycle, and it functions to delay entry of the rack into the treatment. It operates the same way the advanced pick-up does.

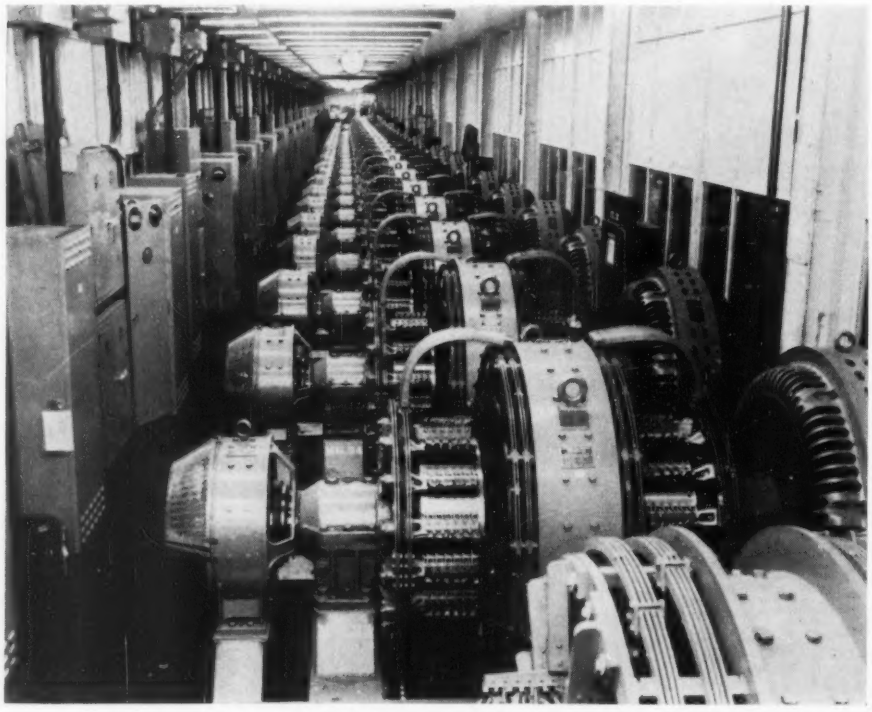

Figure 5. Motor-generator sets for the 24 copper plating cells. Each cell has current supplied by 10,000 amp., 12 volt sets. Starters and PR control panels are shown on the left.

Auxiliary Conveyor System Gives Robot Control

Oldsmobile had to automate the conveying operations before, between and after the three plating steps. To do this, the company obtained an auxiliary conveyor system whose overall length is close to a mile. Conveying takes place on four separate levels, each level being connected by ramps and automatic elevators.

The fixtures carrying racks of bumper bars act like robots in that they automatically find their way to a designated station, their progress being controlled by 3,000 limit switches in the system. The layout of this 5,000-ft. conveyor system could cover several city blocks. More than 2,500

bumpers may be undergoing processing at one time.

Other automatic features of the system include transfer from one loop to another, the by-passing of log jammed areas, and floating on the moving chain when a slow-up occurs.

This power-and-free conveyor system was designed to convey 1,000-pound loads. It is divided into two main parts, namely the copper-nickel and the chromium systems. There are four types of lifts: the two-position type, the three-position type, the offset type and the rotating type. There are 29 lifts in the system.

The lifts include such features as two-speed operation, carrier stabilizers, automatic transfer mechanism on and off the lift section, limit switch protection devices, etc. Two 36″ wide x 72″ high x 9″ deep panels and 30,000 to 40,000 feet of electrical wiring control each lift.

Metal & Thermit Corp. Expanding Facilities

A combined general office, research and distribution center representing a total investment of over $2,000,000 will be established in Rahway, N. J., by *Metal & Thermit Corp., H. E. Martin*, president of the corporation has announced. Located on a 17-acre tract on Rahway Ave., it is scheduled for completion in April, 1956.

New Metal & Thermit center in Rahway, New Jersey, will include, left, research laboratory; center, rear, steam plant and warehouse; center front, pilot plant buildings; right, general office buildings.

At that time the company's executive offices will also be moved to new quarters at 100 Park Ave., New York City, to provide more space for future growth, Mr. Martin said. These offices will be occupied by the firm's senior officers, sales and production executives, technical and executive advisory staff and New York District sales personnel.

The new center at Rahway will include a general office building, a distribution warehouse and a central steam plant as well as the company's existing research facility which is being expanded.

The new office building, a two-story, 80 x 180 foot structure, will house approximately 200 general office employees, a large number of whom are expected to move from the company's present offices in New York City. The

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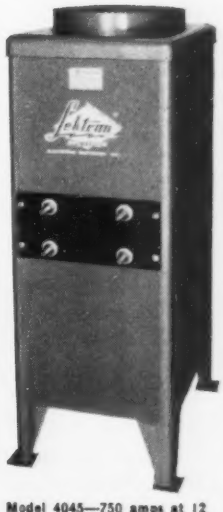
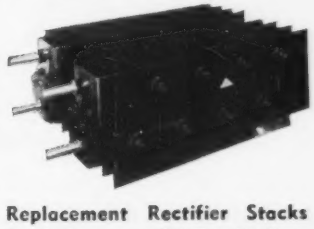
Two styles available—1. Selenium for cool zones, or 2. Magnesium copper sulphide for the hot, dirty jobs. Units still running after 4 years of constant duty.





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Magnesium copper sulphide rectifiers make your plating power supply more rugged and dependable. Magnesium radiator fins for fast heat dissipation and lighter weight. Matching pairs.

Model 4045—750 amps at 12 volts DC—1500 amps. at 6 volts DC. Operates on 208, 220 or 440 A.C. Weight 525 lbs. F.O.B. Indianapolis, Indiana.

SOME JOBBERS AND SALES TERRITORIES OPEN

ELECTRONIC RECTIFIERS, INC.
2102 SPANN AVENUE INDIANAPOLIS 3, INDIANA

new building will be of yellow brick construction to match the research laboratory, erected in 1940. It will be air-conditioned, will contain a cafeteria, and will be provided with ample parking space.

The warehouse building, a one-story structure of 10,000 sq. ft., will provide storage and distribution facilities for the products of all company divisions.

Work has already commenced on a central steam plant, and construction of additional facilities for research in the form of pilot plants and semi-works for organic and inorganic chemicals.

Miller Named East Central Sales Engineer for Engelberg Huller

Howard H. Miller has been named sales engineer in the east central territory for the *Engelberg Huller Co., Inc.*, Syracuse, N. Y. manufacturers of abrasive belt machinery. In making this announcement, *John T. Schenck*, company president, stated that the company is now being represented by a nationwide marketing force.

Howard H. Miller

Mr. Miller will make his headquarters at 12502 Brooklawn Ave., Cleveland, Ohio. His territory will include Ohio, Kentucky, West Virginia, western Pennsylvania and eastern Michigan. He attended Fenn College in Cleveland and acquired industrial experience with the Ohio Crankshaft Company.

Before joining Engelberg Huller, he was on the sales force of the Lakeside Machinery Co. During World War II, he served with the U. S. Marine Corps in the Pacific theater.

Minnesota Mining Appoints Whitcomb

Appointment of *John F. Whitcomb* as general sales manager of the coated abrasives and related products division has been announced by *Minnesota Mining & Mfg. Co.*

Since 1951 Whitcomb has been eastern regional sales manager with headquarters in New York. He joined 3M in 1935 and a year later was made office manager of the New York branch. He became an industrial salesman in 1939 and was made New York automotive trades sales manager in 1944. In 1949 he was promoted to industrial trades sales manager in Chicago.

Sheppard joined the company in 1940 as a salesman. In 1942 he entered the Air Force returning to the firm in 1946. He was promoted to retail sales manager in Chicago in 1948 and in 1950 was named sales manager of stationery trades.

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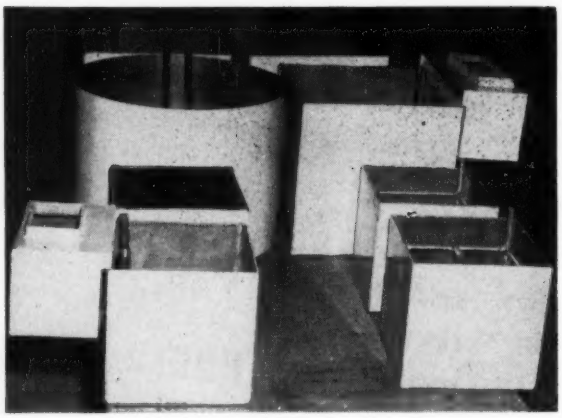

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Manufacturers of Welded Fabrications to Specification

Pennsalt Chemicals Announces Promotion of Sales Executive

Effective July 1, *Stanley Hall*, sales manager of laundry and dry cleaning products department became sales director of the Chemical Specialties Division of the *Pennsylvania Salt Mfg. Co.* In this newly created position, Mr. Hall will be responsible for the national sales activities of the metal processing chemicals, B-K food sanitizing products, corrosion engineering, household products, and laundry and dry cleaning chemicals departments.

Mr. Hall, a grdauate of the University of Massachusetts, joined the Pennsalt chemical specialties organization in 1932. He has been a sales manager since 1943.

Sherman Appointed Dawson Representative

Daniel H. Sherman, Brighton, Mass., has been appointed New England representative for the *Dawson Corp.*, North Pelham, N. Y. manufacturers of the Chromplater industrial chromium plating equipment.

Mr. Sherman, a graduate of Northeastern University with a degree in Chemical Engineering, is a recognized authority on industrial chromium as well as other plating metals. His 10 years experience in this field includes both production and sales. He was recently sales and service engineer for New England with the Ward Leonard Electric Co., Industrial Chromium Division.

Daniel H. Sherman

Lea Plant Damaged

Due to the disastrous flood of August 18-19, some of the Lea Mfg. and Lea-Ronal production in Connecticut will be curtailed for a short time.

Plant C, however was entirely out of the flood zone and undamaged. Hence, Lea compound production and shipments will be fulfilled as soon as utilities are repaired.

Diamond Expands District Office

Its customer service activities having expanded constantly during the past few years, the Memphis branch sales office of *Diamond Alkali Co.* at 1381 Heistan Place will be known henceforth as the Southeastern District Office, according to *R. B. Perry*, manager.

With an office force of seven and a staff of 12 sales and service representatives, the company's Southeastern District Office is responsible for the sale of caustic soda, chlorine and related or derivative chemicals in the states of Alabama, Arkansas, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee.

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NEW, BRIGHT COPPER PROCESS

A One-Material Brightener

FOR ALL BARREL AND STILL CYANIDE SOLUTIONS

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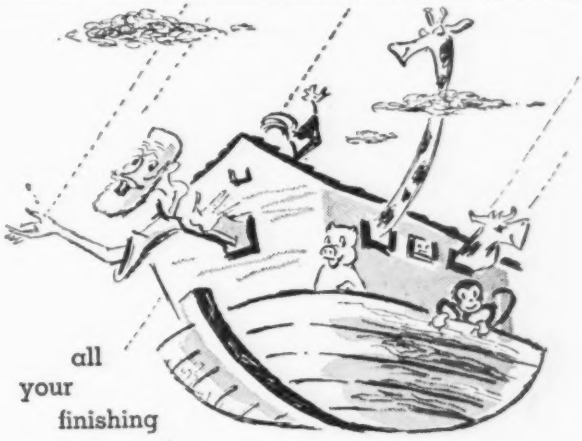

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Manufacturers' Literature

Selenium Rectifiers

Bart-Messing Corp., Dept. MF, 229 Main St., Belleville, N. J.

A 12-page illustrated catalogue, entitled "A Guide to Better Plating Power," covers the manufacturer's complete line of selenium rectifiers.

Illustrated and described are basic and custom designed units with D.C. output ratings ranging from .5 to 50,000 amperes, available in either air-cooled or completely sealed water or oil-cooled models, with all types of automatic controls.

Although the catalogue was originally prepared for the electroplating industry which uses rectifiers extensively, the manufacturer states that requests for this free literature from a broad range of industrial concerns indicate that the contents are of interest and value wherever D.C. power conversion equipment is utilized.

Metal Treatments

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

The above manufacturer of chemical products for the metal finishing industry, announces a new piece of pocket-sized literature with descriptions of twenty series of their special products. The types of products described cover blackening of all metals, new alkaline cleaners, stripping compounds for plated coatings and for lacquers and enamels, buffing compound removal, water displacing compounds, products for treating aluminum, alkaline solutions for removing rust, and protective compounds for iron and steel.

Germanium Rectifiers

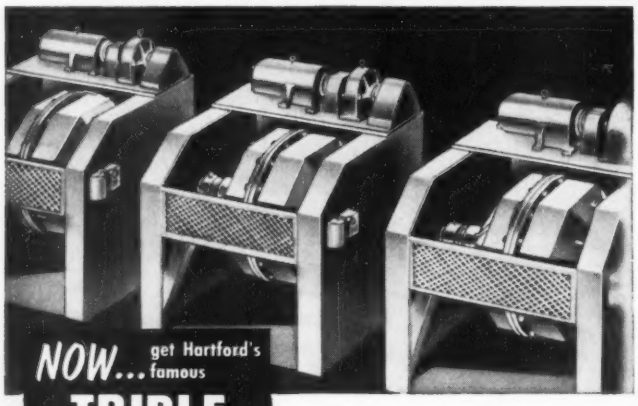
International Rectifier Corp., Dept. MF, 1521 E. Grand Ave., El Segundo, Cal.

A newly published bulletin GPR-1, lists ratings and specifications on germanium power rectifiers. This bulletin describes two styles of the company's rectifier line: Style C, natural convection cooled and Style F, fan cooled. Also included in this bulletin are the complete operating instructions and the typical dynamic characteristic curves for these two germanium power rectifier styles.

Electro Heating of Solutions

Edwin L. Wiegand Co., Dept. MF, 7500 Thomas Blvd., Pittsburgh 8, Pa.

A new 4-page bulletin illustrates and describes a wide range of electric heaters designed for the heating of cleaning, pickling and plating solutions. Types for mounting through tank walls, side arm mounting, various shapes of side hung immersion heaters and special applications of outside-wall clamp-on flat heaters are illustrated. Kilowatt ranges from .6 to 100 with a wide selection of corrosion-resisting sheath materials and automatic thermostatic controls are shown. Special features are overall acid-resistance, completely sealed, extra heavy moisture and shock-proof construction for rugged service requirements. Temperatures are accurately and automatically controlled with individual tank heaters and controls, permitting exact solution temperatures required for the wide work-



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TRIPLE ACTION
in
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cutting barrels

There's a new look in Hartford's Tumbling Barrels... but underneath you get the famous Triple Action Barrel originated by Hartford and unsurpassed for doing a better job ...faster...at lower cost.

Compare these advantages! The Hartford fully enclosed Model 1956 is extremely compact . . . requires less floor space than most enclosed barrels. With Hartford the power unit is on top, where it belongs for long life, cleanliness and ease of maintenance. Barrel is mounted on rugged "A" frame for maximum strength. Streamlined steel enclosure confines splash and contributes to safe operation. Pivoted front guard opens to permit quick, easy loading and unloading . . . plus easy removal of barrel assembly. Standard power unit has four speed gear shift transmission. Literature and prices promptly furnished.

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PRECISION BALLS • RETAINERS
BEARINGS • TUMBLING BARRELS

The Hartford Steel Ball Co., Inc., 13 Jefferson Ave., W. Hartford 6, Conn.

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NEW!
Soft amorphous type
MICRO-SILICA
with these special features

OIL ABSORPTION (G & C)	36.4 to 40.3 LBS.
PH VALUE	5.0 to 5.2
MOISTURE	.5%

A NEW PROCESS SILICA

PARTICLE SIZE RANGE 1 TO 15 MICRONS
98% MINUS 10 MICRONS

New improved equipment assures highest quality and production control

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ing range of different plating operations. Also illustrates high speed, far-infrared heaters for mechanized parts drying and radiant heaters for winter comfort heating.

Chlorinated Solvents

Diamond Alkali Co., Chlorinated Products Div., Dept. MF, 300 Union Commerce Bdg., Cleveland 14, O.

A factual, 14-page technical bulletin concisely reviewing the above manufacturer's complete line of specialized chlorinated solvents has just been issued and is now being distributed among chemical research, processing, purchasing, and other interested executives.

Products discussed in the bulletin, entitled "Diamond Chlorinated Solvents," are methyl chloride, methylene chloride, chloroform, carbon tetrachloride, and perchlorethylene.

The bulletin presents, in easy-to-read, quick-reference digest form, basic data on each product—description, physical properties, typical shipping analysis, major uses, handling precautions, and size of containers for shipment.

Oxidizing Compound

Krembs & Co., Dept. MF, 669 W. Ohio St., Chicago 10, Ill.

A bulletin issued by the above company lists the many advantages of Oxy-Dyz-Ene as an oxidizing agent for the use in giving copper, brass, silver, steel, iron, bronze, etc. various shades of finish.

Glass Fiber Filter Discs

Friedrich & Dimmock, Inc., Dept. MF, Lincoln Ave., Millville, N. J.

"Glass Fiber Filter Discs," a new four-page, two color bulletin covering a complete range of septa for every commercial use, pictures and describes filter discs and gives the shapes, fiber diameters, disc diameters, disc thicknesses and disc densities available.

Besides the filter discs, the bulletin describes other glass fiber products, filter rolls, skeins and mats.

Roof Ventilators

The Hartzell Propeller Fan Co., Dept. MF, Piqua, O.

Dimensions, specifications, and performance data on the complete line are now available in the new Roof Ventilator Catalog A-112, just released by the company. This twelve page, illustrated catalog carries information and pictures on two new models, the Vertijet, an efficient low priced roof ventilator, and a Stack Cap designed for simple, economical duct exhaust systems.

Automatic Valve Positioner

Barber-Colman Co., Wheelco Instruments Div., Dept. MF, Rockford, Ill.

A new bulletin, F5991-1, describes the Wheelco Throttltrol, an automatic valve positioner for use in conjunction with any control instrument having a "high" and "low" contact with a neutral position.

The device automatically and accurately corrects for variations in heat requirements due to changes in furnace load, control settings, air and fuel pressure, BTU values, or combustion efficiency in batch type operations. The unit is completely self-adjusting and requires no manual adjustments or resetting devices.

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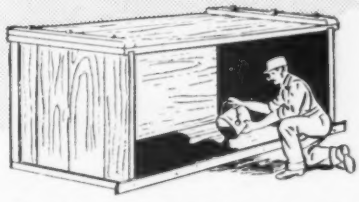
Easy to Apply RUBBERITE TANK LINING



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Provides a lasting lining that withstands acids and caustics at room temperatures. A standby of Platers for over 25 years. Effectively protects wood or steel tanks. Easily applied in your own shop—just turn tank on side and fasten board on edge as illustrated. Then heat Belke Rubberite to 300° F. and pour over surface. Surfaces to be coated require no special preparation but should be reasonably clean.

When Rubberite cools, it has characteristics similar to soft rubber. Will not crack, scale, or run in the hottest weather. Write for complete information.

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EVERYTHING FOR PLATING PLANTS

High Vacuum Pumps

Kinney Mfg. Div., The New York Air Brake Co., Dept. MF, 3640 Washington St., Boston 30, Mass.

A new 52-page catalog, No. 425, is attractively printed in two colors, profusely illustrated, and contains many cutaway drawings, diagrams, graphs, performance curves, installation pictures, tabulations of data, conversion tables, charts and formulae. This publication is stated to be a comprehensive vacuum engineering reference book.

The catalog section devotes many pages to the compound, single stage simplex, single stage duplex and two-stage mechanical booster high vacuum pumps in the company line.

The text describes details of construction, indicates over fifty different fields where these pumps are used, discusses characteristics of the operating mechanisms, gives details of the oil sealing and lubricating systems, valve construction, air-oil separation, and controlled gas ballasting, also other methods to eliminate sealing oil contamination. It also presents complete specifications, capacities, dimensions and weights of all models and sizes.

Photographs of all types of pumps are included, and line drawings in two colors indicate vapor flow and steps in the operating cycle.

The engineering section discusses high and low absolute pressure requirements, degree of vacuum attainable, factors determining type and size of pump required, displacement required to pump down, pumping speed required for a given gas flow, pump sizes for dry systems, determination of pipe sizes, selection of vacuum tight valves and gauge connections, the influence of condensable vapors and other technical aspects of vacuum pump application engineering.

Propeller Fans

Hartzell Propeller Fan Co., Dept. MF, Piqua, Ohio

Two new models, a by-pass duct fan and a double ring reversible fan are included in the latest Propeller Fan Catalog, A-109A, published by the company.

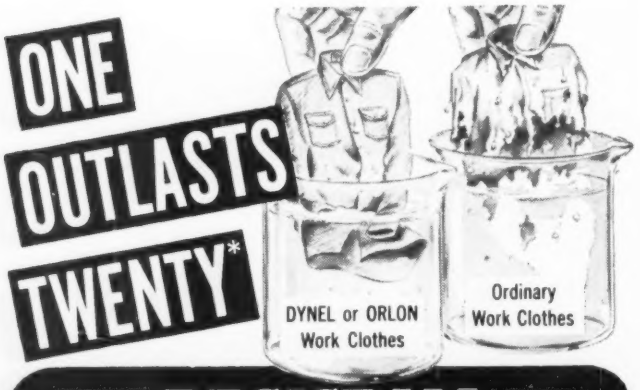
In addition to the information on the two new fans, specifications, dimensions, and performance figures are given on eighteen other types of industrial ventilating fans plus intake units, unit heaters and accessories.

Instruments for Surface Measurement

Brush Electronics Co., Dept. MF, 3405 Perkins Ave., Cleveland 14, O.

New literature highlights the Surfindicator, a versatile gage for surface roughness measurement. The instrument is portable, inexpensive, easy to operate and adaptable to a wide range of applications.

One section of the folder is devoted to accessories, designed to broaden the applications of the instrument. These include a motor drive, which provides a mechanical movement of the pickup along a surface being inspected. Seven models of special purpose adapter type pickups are likewise illustrated and described: the general purpose pickup, the small bore adapter, the minimum clearance adapter, the rough finish adapter, the chisel stylus adapter, the hole bottom adapter and the handheld small bore adapter.



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Acid and Caustic Resistant
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* outlast wool and cotton 20 to 1 or better under specific chemical conditions.

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Top-quality, low-cost
ZINC SOLUTION PURIFIER
Eliminates heavy metal impurities, including copper.
Prevents harmful build-up of carbonates.
A complete cleansing treatment: — No other purification measures necessary.
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228 McKeon Way
Greensburg, Pa.

Still another section is devoted to a description of the Metal Indicator, a portable shop instrument for identifying metals by comparison with known samples. Also described is the Surface Analyzer, which provides an instantaneous and permanent chart record of a highly magnified profile of a surface.

Liquid Blast Cleaning

Pangborn Corporation, Dept. MF, P. O. Box 380, Hagerstown, Md.

The above manufacturer has announced the availability of Bulletin No. 1403 on Hydro-Finish liquid blast cleaning equipment.

This new 8-page bulletin contains photographs, detailed drawings, dimensions, sizes and features of all models of the EZ-2 and EZ-3 machines.

Design of Water Clarifiers and Softeners

Graver Water Conditioning Co., Dept. MF, 216 West 14th St., New York 11, N. Y.

Technical reprint T-135 "Design of Water Clarifiers and Cold Process Softeners" is an informative paper which emphasizes the need for good engineering and intelligent selection of equipment to meet specific applications. It thoroughly discusses the many operating factors affecting the dependability and economy of this type of equipment.

The paper is illustrated with many diagrams, drawings and photographs.

Stainless Steel Globe Valves

Cooper Alloy Corp., Dept. MF, Hillside, N. J.

The availability of a condensed catalog showing the major stainless steel globe valves in the above company's line has just been announced. In addition to schematic drawings of the various valves the booklet includes a section on design factors. It also contains a table of major stainless alloys, giving their designations and applications. Copies available on request. Ask for Bulletin 55A.

Temperature Instruments

Fischer & Porter Co., Dept. MF, Hatboro 35, Pa.

The complete line of the above manufacturer's filled thermal systems for indicating, recording, controlling, transmitting, compensating, and programming temperatures from -400 to +1,000 degrees Fahrenheit are illustrated and described in a catalog just published.

Shown for the first time in the 24-page Catalog 12-A-10 is the vapor pressure filled systems recently added by the firm to expand its line of liquid expansion and gas pressure filled systems. Two tables compare temperature ranges and other properties of the three systems to help the reader select the best one for his application.

All sensitive bulbs, union connected bulb assemblies, bushings and wells used in the temperature instruments are shown in the catalog.

Instruments shown in the booklet include temperature recorders, indicators, dial indicators, recording controllers, indicating controllers, indicating and non-indicating transmitters, program recording controllers, psychrometric instruments (to record wet and dry bulb temperatures), and portable temperature instruments.

The catalog also describes alarms,

SPOT

- NICKEL ANODES
- NICKEL CATHODES
- NICKEL SULFATE
- NICKEL CHLORIDE
- NICKEL CARBONATE
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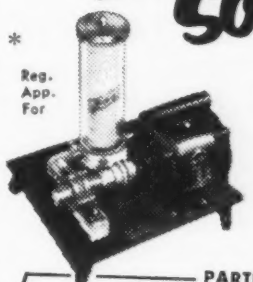

Reg. App. For

50-2400 GAL/HR.

Self-priming Model LSIN-10 . . . Cap. 100 gal/hr. H.T. Lucite Filter Assembly. Stainless pump . . . totally enclosed Motor . . . portable . . . Wt. 60 lbs. . . . 14"x16"x16" high.

Distributors in principal cities. *Write for literature.*

PARTIAL LIST OF MODELS

Model	Rated Capacity	Overall Size	Weight
LSI-5	50 gal/hr	11"x14"x12"	30 lbs.
LSI-10	100 gal/hr	12"x16"x16"	40 lbs.
ASI-300	300 gal/hr	2'x2'x2'	125 lbs.
ASI-600	600 gal/hr	2'x2'x2'	150 lbs.
RLS-1200	1800 gal/hr	2'x3'x3'	300 lbs.

SERVICE . . . Filters practically any acid or alkaline solution from pH 0 to pH 14; removes particles down to one micron in size. Strainer stops metallic objects.
DESIGN . . . **Filter Assembly** fabricated of stainless steel 316, high temperature lucite, rubber-lined, Haveg or Sethrin* resin. **Filter Tubes** of cotton, dynel, porous stone or porous carbon. **Pumps** fabricated of Hastelloy, stainless 316 or plastic; centrifugal or self-priming. **Motors** drip-proof, totally enclosed, or explosion proof, 110 or 220 volt, single or three-phase, 50 or 60 cycle, sleeve or ball bearing. **Hose** — special acid and alkali resistant. **Base** — Linen Phenolic laminate on rubber tire ball bearing casters.

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compensators, instrument case accessories, temperature scales, and recording charts. Two illustrated pages show typical sensitive bulb installations in pipes; driers, ducts and flues; and kettles, tanks and vats.

Waste Treatment of Cyanides & Chromic Acid

Fischer & Porter Co., Dept. MF, Hatboro 35, Pa.

By means of flow diagrams this 16-page booklet, Bull. 90-242-10, illustrates most common methods of treating cyanide and hexavalent chromium wastes and the applications of the company's instrumentation for controlling the processes. Instruments used are illustrated and described.

The three basic systems for alkaline chlorination of cyanides and reduction of chromic acids—batch, continuous, and integrated—are described in detail. In all three systems, automatic control assures complete destruction of toxic wastes without using excessive quantities of treatment chemicals.

Also described and illustrated is the new integrated waste treatment system, developed by *Dr. Leslie Lancy*, an electroplating specialist and consultant to the firm.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Newark Branch

The Newark Branch assembled at the Ballantine Brewery forty strong for the last meeting of the year on June 17. After a visit through the very fine establishment—beer and sandwishes were served while *Don Foulke* presented just as non-technical a paper on nickel plating as one would expect of a speaker using a bar as a rostrum.

During the brief business meeting *Thomas Wulff*, *Fremont L. Scott* and *Robert Fowler* were elected members of the branch. *Charles T. Smith* transferred to Waterbury Branch and *Lewis M. Brown* was reinstated.

D. Gardner Foulke
Secretary

AMERICAN SOCIETY FOR METALS

On Monday, October 17, 1955 and continuing through Friday, October 21, of that week, the American Society for Metals will present the 37th Annual National Metal Congress and Exposition—"The Metal Show" — in Philadelphia, Pa.

The congress will be held in the headquarter hotels of the participating Societies; the exposition will be held in Philadelphia's Convention Halls, near the campus of the University of Pennsylvania.

The 1955 Metal Show will be the 6th of this annual event to be held in Philadelphia and will be the largest of the six.

According to *W. H. Eisenman*, man-

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aging director of the annual event, 245,610 square feet of space is to be utilized for the display and operation of equipment, products, and services. Over 400 firms will occupy spaces in the Arena, Exhibition Hall, the South and Center Buildings and the Commercial Museum. There will be a diversity of interests in the display and operation at the hundreds of exhibitor booths—ranging from new developments in spot welding to the latest in testing and finishing.

AMERICAN SOCIETY FOR METALS

For the third consecutive year, the *American Society for Metals* will award scholarships in metallurgy to 49 leading engineering schools in the United States and Canada.

The ASM scholarships in metallurgy are a part of the program sponsored by the Society's Foundation for Education and Research. A total of 129 $400.00 scholarships have been awarded through the American and Canadian engineering schools having undergraduate degree courses in metallurgy.

According to *W. H. Eisenman*, national secretary of ASM, the purpose of the scholarships is to stimulate greater interest in this engineering field, with the objective of a greater supply of metallurgical engineers so vitally needed by industry.

The scholarship grants are made without the Society's participation in the selection of a winner. The scholarship grant is paid to the university, and the school's Department of Metallurgy makes the selection of a winner upon the basis of his scholarship and financial need.

LETTER TO THE EDITOR

Metal Finishing
381 Broadway
Westwood, N. J.

Dear Sirs:

I am forced to cease renewing my subscription to your fine METAL FINISHING. Due to arthritis I am giving up the electroplating practice. Your magazine was very good 40 years ago, and has improved one hundred per cent.

I wish your editorials at times would give honor to fine men like Charles Proctor, Sizelove and others of the Old Guard who did not have the facilities and foundation of the boys of today, who do not have to overcome the troubles and problems of yesteryear.

Again, I hate to part with my favortie magazine, which was good years ago and is good now.

Yours truly,
/s/ Adam Tabacek
1839 N. Keystone Ave.
Chicago 39, Ill.

P.S. The radio field honors men like Marconi, De Forest, and others, even if their gadgets were crude. Why not have the metal finishing field honor the old boys, instead of priding themselves on developments the old boys sweated over?

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News from California

By Fred A. Herr

Rhys N. Ricky, who has been active in the lead burning and plastic corrosion protection fields since his return in 1946 from service with the Aerial Photographic Division, U. S. Air Force, joined the sales engineering staff of Western Process & Equipment Co., Los Angeles, effective July 1. In his new post he covers all of California. Western Process & Equipment is a sister firm of L. W. Le Fort Co. of Los Angeles, one of the pioneers in lead burning on the West Coast.

Don Bedwell, plant superintendent of the Hall-Mak Co., Los Angeles plumbing fixture manufacturers and finishers, and Mrs. Bedwell, recently spent an entire month in the Hawaiian Islands, the culmination of a dream of many years standing.

Don said he forgot about plating entirely and completely for their entire 30-day stay on the Magic Isles. They delved enthusiastically into all the tourist attractions and entertainment which the islands have to offer, but plating shops—"Nothing doing," said Don. "The closest I came to one is when I phoned to say hello to *J. C. Hardy*, owner of the Automotive Service, Ltd., one of the three plating shops in Hawaii."

But Hardy was not there. He was on a trip to the mainland. So Don did not look another plating tank in its anode until he got back to the Hal-Mak shop in Los Angeles a month later.

Kasmer F. Tarczynski, general manager of Superchrome Engineering Co., Los Angeles, recently returned from a three weeks business trip to Salt Lake City, Utah, and various oil producing centers in Texas, including Fort Worth, Dallas, Houston, San Antonio and El Paso.

Since his firm does considerable volume of work in plating core barrels and liners for oil well drilling operators, Tarczynski devoted the major portion of his trip to visits to Texas oil fields, and also toured the Hughes Tool Co. plant in Houston.

He reports that for the first time, his firm has taken on a contract for hard chromium plating 30-foot long oil well liners of 4¾" I.D. Heretofore, liners of 2⅝" diameter were the heaviest the firm had handled in its 45-foot-deep outdoor plating tank.

Swanney, McDonald & Williams, manufacturers of stainless steel automotive accessories, have concluded an extensive expansion program at their plant, 2929 N. Ontario St., Burbank, Calif. The major phase of expansion involved the installation of a roll forming department, electronically controlled, for pre-notching and punching metal before forming. Three rolls, an electronic control system, punch presses and punch brake were among the new equipment installed. The new division is geared for high-production performance to produce completely

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formed, notched and punched parts.

The company operates a polishing department equipped with 20 double spindle polishing lathes, including 12 stations with 6-head automatic polishers. *Harry L. Williams* is co-owner, and *Fred C. Marshall*, plant foreman.

Plant and laboratory tours dealing with the development, manufacture and finishing of electronic parts and equipment featured a three-day Western Electronic Show and Convention held in San Francisco August 24, 25 and 26. A total of 570 exhibitors sponsored booths in the San Francisco Civic Auditorium.

Two field trips were made on each of the three days. Opening day was highlighted by a morning visit to the Radiation Laboratory of the University of California, Berkeley, as part of which a lecture was presented describing the 6BEV bevatron. Other field trips were made to the Scientific Division, Beckman Instruments, Inc., Berkeley; the Eitel-McCullough and Ampex Corp., plants, the Stanford Research Institute, Palo Alto, and the Hewlett-Packard plant, Palo Alto.

Beckman Instruments, Inc., Fullerton, Calif., reports that *Dr. William S. Gallaway* has rejoined the organization as supervisor of infrared applications. In his new post, Dr. Gallaway will specialize in infrared and spectroscopy applications with emphasis on integrating them with automatic process control instrumentation. He was formerly a member of the research and development staff.

McKenna Laboratories, Santa Monica, Calif., reports the appointment of two eastern laboratory supply houses as distributors of its line of laboratory equipment. Harshaw Scientific Co., Cleveland, O., will represent McKenna products in 18 eastern and Southern States, and in California through Harshaw Chemical's Los Angeles branch. Atlantex Corp., Boston, Mass., will serve as distributor in the New England States.

One hundred plating and polishing show owners, foremen and supervisors of the Los Angeles, Calif., area, were guests of the J .J. Siefen Co. of Detroit, Mich., at that firm's first West Coast symposium on spraying buffing compounds at the Los Angeles Ambassador Hotel in separate sessions on July 18 and 19.

Approximately 50 Southern California operators attended each of the conferences and demonstrations. The program consisted of a social hour from 6 to 7 p.m., dinner at 7 p.m., and a lecture and demonstration on spray buffing methods beginning at 8 p.m.

The Los Angeles program was an extension of the company's schedule of classes of its free school of spraying of buffing compounds, which have been held in a number of mid-western and eastern cities. The program was geared to the level of supervisory and operating personnel who desire more knowledge to enable them to reduce costs and increase production.

Installation of a new hot dip wire galvanizing line was recently completed in the Los Angeles plant of the Bethlehem Pacific Coast Steel Corp. The new line is 356 feet long and is designed to handle 40 strands of wire at one time. It is set up to galvanize wire in sizes ranging from 5/16" to 18" gauge and, by the use of various combinations and speeds on the take-up frames, can galvanize various sizes of wire simultaneously.

The installation is designed so that strand annealed wire can be produced by by-passing the zinc dip operations. After being drawn to the desired diameter, wire stocks start their passage through the galvanizing line from pay-off reels which have a 1000-pound rated capacity. Then they move through the molten lead pans and are submerged in hot lead for annealing. Subsequent operations involve a water rinse, zinc-ammonium chloride flux, cleaning tank, and molten zinc bath at 850°F.

Gordon A. Jacobs, formerly assistant manager, has been named Pacific Coast regional manager of Detrex Corp., with headquarters in Los Angeles. He succeeded *R. B. Carlyle* who has been transferred to Cincinnati, O., as central regional manager. Jacobs started his tenure with the company as a sales engineer in San Francisco. In the next five years, before moving up

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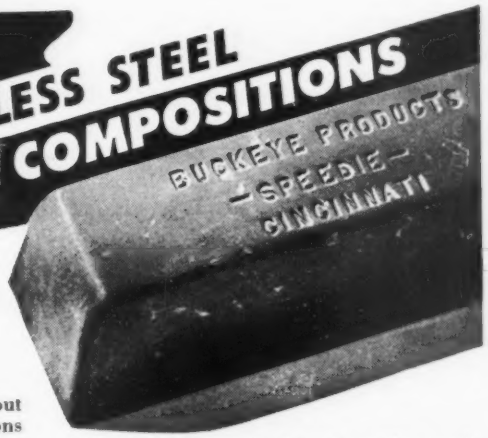

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to assistant regional manager on the West Coast, he served in sales capacities in Los Angeles, Dallas and Detroit.

Haskell J. Miller, president, Speed-D-Burr Corp., Glendale, Cal., manufacturers of precision barrel finishing equipment, reports the appointment of *William T. Elmas* as sales and technical engineer in the Los Angeles area.

Wm. T. Elmas — H. J. Miller

Elmas recently moved to Southern California from New Haven, Conn. He has had a long and varied experience with a prominent eastern manufacturer of barrel finishing equipment and, prior to that, was associated with a metal finishing firm. In covering the Los Angeles territory, Elmas will make available his extensive engineering background and knowledge of finishing requirements, compounds and media to manufacturers using barrel finishing equipment of all types.

Speed-D-Burr was, until July 1, a division of Miller Machine Tool & Gauge Co. of Glendale. On that date it was changed into a separate corporation with individual name in order better to meet the demand for barrel finishing equipment. The new concern conducts its operations in offices and factory located at 3613 San Fernando Road, Glendale 4, Cal.

California Metal Engineering Co., Los Angeles, has completed a $50,000 expansion program involving the installation of new equipment and production lines for producing porcelain enameled aluminum. Major items include a furnace, dryer and spray line. The new facilities enable the firm to turn out porcelain coated aluminum sheets up to 10 feet in length.

Cannon Electric Co., manufacturers of electrical plugs and panels, has announced plans for construction of a new administration and engineering building across the street from its main Los Angeles plant, 3209 Humboldt St. Land, building and equipment will involve an outlay of $450,000, it was reported. The new building will include space for executive offices, enlarged facilities for the sales and engineering divisions, and a new testing laboratory. No additions to the company's plating and polishing departments are contemplated as part of the current enlargement program.

OBITUARY

FRANCIS J. STOKES

Francis Joseph Stokes, 81, industrialist and naturalist whose home was at 629 Church Lane, Germantown, Pa. died August 1 at Germantown Hospital, after a brief illness.

Mr. Stokes was born in Philadelphia on December 24, 1873, the son of Francis and Katherine Stokes. He attended the Germantown Friends School and Haverford College, graduating in 1894 with an A.B. degree. After serving a year as an apprentice machinist to Robert Shoomaker, of Philadelphia, he purchased his employer's business and operated it from then on as the F. J. Stokes Machine Company. Mr. Stokes was president of the Stokes company until 1948, when he became chairman of the board, holding this position until his death.

For many years he was vice-president of the Ludwick Institute of Philadelphia, a non-profit organization devoted to encouraging study and research in natural history. He was a long-time member of the American Chemical Society, the Franklin Institute, the Academy of Natural Sciences, and the Zoological Society of Philadelphia. He was also a member of the Academy of Fine Arts and the Philadelphia Art Museum, and of the Antiquarian and Numismatic Society of Philadelphia.

Mr. Stokes was a member of the Coulter Street Meeting House of the Society of Friends, in Germantown. Funeral services were held there at 4 p.m., on Wednesday, August 3.

Mr. Stokes is survived by his wife, Lelia Woodruff Stokes, a native of Scranton, Pa., four sons, F. Joseph Stokes, Jr., of Philadelphia; Allen W. Stokes, of Logan, Utah; Henry W. Stokes, of Hingham, Mass.; and David E. Stokes, of Jenkintown, Pa.; and a daughter, Alison, (Mrs. Paul B. MacLean), of Hamden, Conn. He had 19 grandchildren.

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750/375	6/12	Excel
940	32	Elec. Prod.
1000/500	6/12	H-V-W
1500	13	Columbia
1500	30/50	Century
1500	40/65	G. E.
1500	70	Century
2000/1000	6/12	H-V-W
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5000/2500	9/18	Chandeysson

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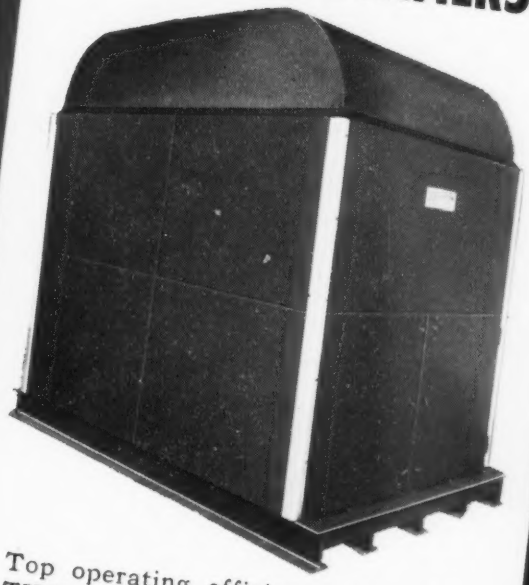

Top operating efficiency AT ALL TIMES because they cannot corrode... require no maintenance...never need cleaning. The cabinet is gasketed and sealed to withstand highly corrosive atmospheres. Air within the cabinet is cooled by an air-to-water heat exchanger.

There is a Sel-Rex Rectifier for every type Power requirement. A staff of well-trained personnel is provided to assist you in conducting an economical and highly efficient plating operation.

Sel-Rex DOUBLE DUTY FILTERS

Efficient LOW-COST operation with either ANNULAR bag element or POROUS STONE.

Cuts filter cleaning time to less than 15 minutes! Can be operated *by anyone immediately*. The entire Annular element is secured to the tank cover—lifts out freely and easily for cleaning, either by hand or with the sturdy, hand-operated davit mounted on the tank of larger units. Messy handling of wet and dirty elements is eliminated — you can even clean an element used for carbon treatment without soiling your hands!

The compact design saves valuable shop space—the new Annular element gives DOUBLE the amount of filtration area and speed in the same space required by other filters. Standard models from 250-18,000 GPH capacity.

Larger models built to specifications.

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How did one of the largest producers of plated diecastings in the automotive field lower costs and reduce rejects to less than 1% while producing the largest volume of plated work in their history?
They used the following complete MacDermid Incorporated cleaning cycle.

1 Soak Clean — METEX 203X

Heavily impacted buffing compound is removed in Metex 203X emulsion, which is used 5% by volume with water, at a temperature of 140°F. A mineral solvent layer is floated on top usually ½ to 1" in depth. Immersion time 1 to 2 minutes.

If emulsion cleaning is not desirable for any reason, Metex S-402 is recommended. Metex S-402 is a liquid solvent used 2-4% by volume at 150-160°F. Slight agitation is highly desirable. Removes buffing compounds in one to three minutes.

2 Spray Clean — METEX D SPECIAL

A highly inhibited alkaline spray cleaner that will not tarnish etch, or discolor highly buffed diecastings. Used 1 to 2 oz. per gallon at 150°F.

If added detergency is required, METEX A SPECIAL is recommended, as it may be used as high as 4 oz./gal. at 150°F. without foaming.

3 Electrocleaning — DYCLENE ES

Heavily inhibited alkaline reverse electrocleaner. Will not etch or discolor at 8 oz./gal., 190°F., 6 volts, even for prolonged cleaning periods. When used anodically, perfectly activates the zinc surface so that the resultant electroplate will be bright, adherent, and will not blister.

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